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Planing Machine.

The cut illustrates planing machines of four feet capacity and larger, as built by Bement, Miles & Co., Philadelphia. In each case the width and height are such as to admit, in the rough, work which will finish to the full nominal capacity of the machine.

The driving gear is so arranged that the bed will be parallel with the line shafting; all the gearing and the rack are accurately cut; the power is ample for taking four heavy cuts easily and smoothly, returning the table at seventy to one hundred feet per minute, and corresponding stiffness and strength are provided in all the parts.

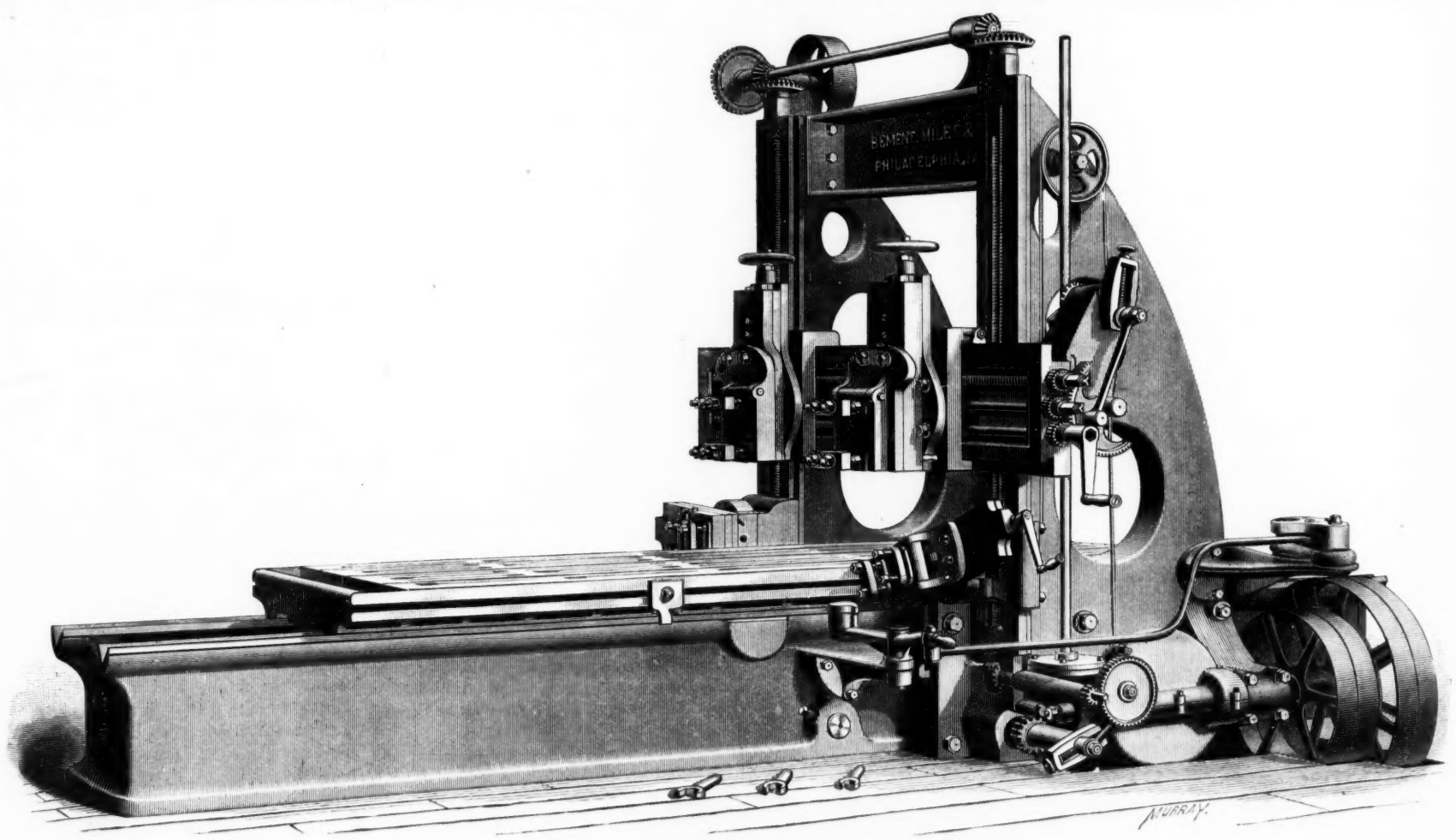
The double-webbed construction of the uprights gives them unusual stiffness and is particularly advantageous when side heads are used, as is usual in large planers. The entire broad front of the uprights is utilized for the support of the side heads, which are counterbalanced, have automatic vertical feed to the full capacity of the machine, and are provided with swivels for angular planing.

The table can be stopped, started and reversed from either side.

The cross slide is raised and lowered by power and carries two heads which have self-acting, independent, variable feeds in all directions, operated at either end of the cut directly by the driving gear, from which they are automatically disconnected when not actually in motion, so that they consume power only while feeding. All the feeds are conveniently controlled from the usual position of the operator. The internal reversing pawls are moved by thumb latches projecting from the ends of the cross shaft and screws, by which arrangement each head can be made to feed in any direction, independently of the other heads.

The tool aprons are set over, so as to admit of the tools being brought very near each other, and the cross slide is of such length that when one head is at the extreme end the other will cut over the entire width between uprights.

The Vs in the bed have broad surfaces, and are effectually lubricated by patent rollers enclosed in oil pockets.



PLANING MACHINE.

There seems to be a growing complaint of discrimination by the railroads in the matter of freight-car service, some mine owners charging that cars for shipments are not furnished them in anything like adequate numbers, the object seeming to be to make the mines unprofitable, that they may be purchased by the roads or their friends at reduced prices. Of course the roads deny any such purpose, and in some cases the matter has been taken before the commission appointed under the Inter-State Commerce Law for settlement.

Considerable has been done in Europe recently in the way of experiments for the purpose of determining the comparative value of sand and a water jet for preventing the slipping of locomotive driving wheels. The results seem to be in favor of the water jet, in the points of economy and decreased wear on rails and tires. While it is not claimed that by the use of the water jet, quite as much adhesion is secured, yet the decreased resistance to motion of the wheels of the train, as compared with sand, more than overbalances this, and it is said that engineers, after trying it, give their preference to the water.

The Milling Machine as a Substitute for the Planer in Machine Construction.

BY JOHN J. GRANT, PHILADELPHIA, PA.

A PAPER PRESENTED AT THE PHILADELPHIA MEETING OF MECHANICAL ENGINEERS.

Finishing surfaces by rotary cutters, or, in machine shop vernacular, milling, has not received the attention from mechanics and proprietors of machine and tool factories which it deserves. There appears now, however, an awakening among engineers to the importance of using the milling machine as a substitute for the planer, and it is safe to prophesy that the places of the two machines will be reversed, and the planer become the jobbing tool, instead of the milling machine as now. During the years 1861 to 1865 inclusive, more was done toward the development of the milling machine than in fifty years of previous experimenting. The use of the milling machine has made it possible to produce the parts of guns, pistols, sewing machines and other articles of a similar nature, at a trifling expense as compared with the planer, or the old and tedious method of jig filing. That it has attained a very high state of perfection in the above branches of machine work is well known to all mechanics: that it should have been neglected, and not developed in the field—much wider and of quite as much importance—of general machine building, is no less a mystery.

There is no reason why the milling machine should not be used to finish the various parts of machine tools, locomotive, or stationary engines and other large machinery. It may be asserted that there is no part of a locomotive now finished on the planer which cannot be done on the milling machine, if properly designed for such work, and at a cost of from one-half to one-tenth, besides, in most cases, producing far better work and nearer to interchangeability.

In conversation with master mechanics, superintendents of shops, and others interested in such matters, the reason given for not using the milling machine has been the cost for cutters, and in return the answer should be that milling cutters are not as expensive as the single-pointed planer tool, to produce a given amount of work. This is known from an experiment made by myself, which was as follows, and although not absolutely correct, is sufficiently so to make the relative cost of producing work on the planer and milling machine obviously in favor of the latter.

One hundred pieces of cast-iron 16 inches long, large enough to finish 1½ inches by 1 inch, used for lathe racks, were given to the man in charge of the milling machine, and an equal number of the same pieces to the man in charge of the planers. The cutter used on the milling machine was simply a plain spiral cutter, of 2¼ inches diameter by 2 inches in length, costing to make in the shop, including stock, labor and shop expenses, two dollars and ten cents. This cutter was sharpened but once,

and that, after the completion of the job, which consisted in roughing the four sides of the 100 pieces. The periphery speed of the cutter was 26 feet per minute and the feed 3 $\frac{5}{10}$ inches per minute; time consumed, 44 hours, 39 minutes. Two milling machines were used—one for roughing and one for finishing cuts. The cutters required grinding at the end of the job, and so were chargeable to it; the time required to grind them was 22 minutes. The wages of boy running the machine was 9 cents per hour. The total cost for finishing the 100 pieces on the milling machine was as follows:

44 hours, 39 minutes, at 4½ cents each, per hour	$3.99
Sharpening cutters, 22 minutes, at 30 cents per hour	.11
Shop expenses at 35 per cent. of labor	1.39
Total cost	$5.49

The cost of the same number of pieces finished on the planer was as follows:

Planers used were two 16 inches square by 3 feet; platen running 24 feet per minute cutting speed; return 2 to 1; the feed was as coarse as could be used on the roughing cut—that is, about 22 per inch. Time consumed on each planer, 25 hours, 46 minutes; wages of man running the planer was 25 cents per hour. The total cost for finishing the 100 pieces on the planer was as follows:

24 hours, 35 minutes each machine, at 25 cents per hour	$6.03
Grinding and setting tool 19 times, 1 hour, 21 minutes	.33
Shop expenses, 35 per cent.	2.22
Total cost	$8.58
Balance in favor of milling machine	3.09

This, you will bear in mind, is showing the planer to its best, and the milling machine to its worst advantage. Where the milling machine makes the best showing is in irregular work, which, in the planer, requires the constant attendance of the workman—such as planing close to shoulders, cutting bevels and T slots, and jobs of a similar nature.

The advantage of the milling machine is then seen, as the cost for attendance is, often, not one-tenth, owing to the fact that a much cheaper workman can run several machines. The cost of tools in each case was as follows:

Milling cutters, first cost, $2.10 each	$4.20
Grinding once, 22 minutes	.11
Total cost	$4.31
Planer tools, first cost, 42 cents	$ .84
Re-dressing by smith, once	.16
Grinding and setting roughing tools 19 times, 1 hour, 21 minutes	.33
Grinding and setting finishing tool 6 times	.10
Total cost	$1.43
Expense of keeping tools in order on milling machine	$0.11
And for planer	.59
Balance in favor of milling machine	.48

This does not include the time of workman's loafing in the smith shop, this trouble being entirely done away with in the milling cutter. The milling tools after this trial showed no perceptible wear, or difference in size, and it is safe to say that they would finish fifty such lots of 100 pieces. The cost for tools in that case would be about as follows:

Milling machines, first cost	$4.20
Grinding 50 times at 11 cents	5.50
Total cost	9.70
Planer tools, first cost	$ .84
Re dressing roughing tools 50 times at 16 cents	8.00
Grinding and setting 950 times at 1 73-100 cents	16.43
Finishing tool 10 times at 16 cents	1.60
Grinding 300 times at 1 73-100	5.19
Total cost	$32.06
Balance in favor of milling tools	$22.36

This calculation on the life of milling cutters is based on what has actually been done in the American Sewing Machine Company's works, where I now have charge. Since February 15th of this year up to the present writing—Sept. 14th—there has been finished by one set of cutters, about 15,000 sewing machine beds, the cut being about 6 inches long. These cutters have been ground but five times and show but very little reduction in size. Common sense teaches that a continuous rotary cutting motion will produce more work than a reciprocating, or intermittent one. If inventors would turn their attention to the further development of the milling machine, for general machine work, instead of the quick return of planers, they would benefit

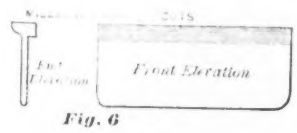
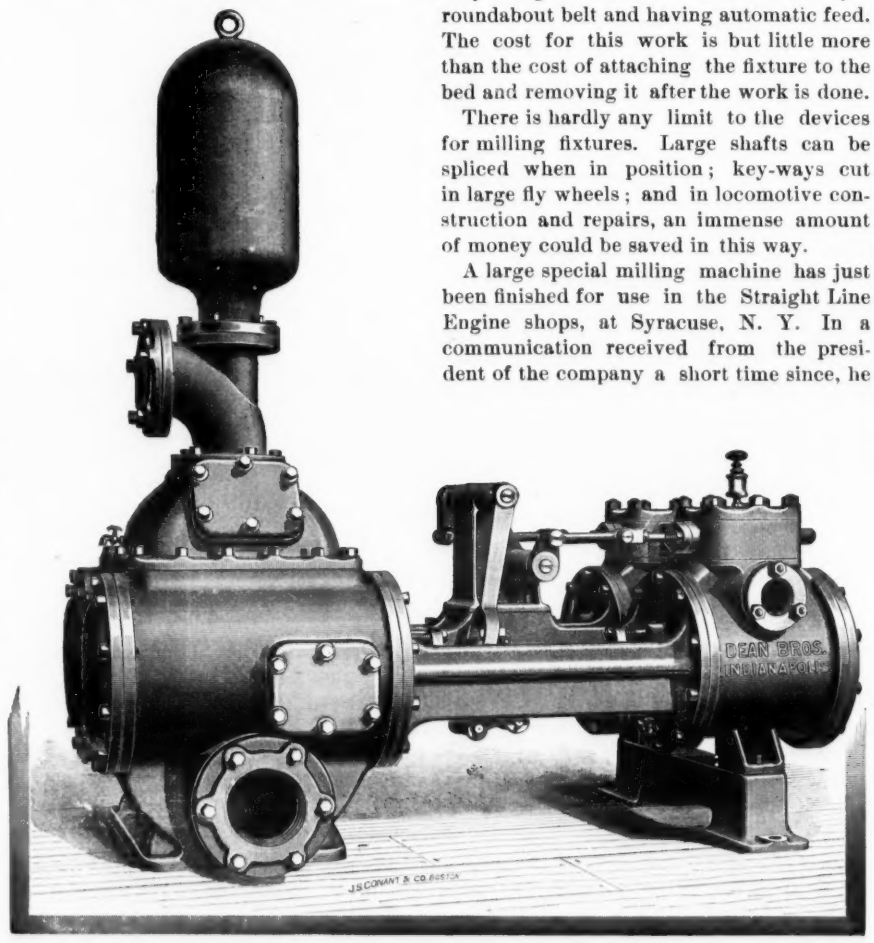


Fig. 6

themselves and be doing the mechanical world better service. Some of our large machine and tool builders are using the milling machine to their great advantage. The following may be mentioned, who, to my knowledge are using regular and specially designed milling machines to their profit. Brown & Sharpe Manufacturing Co., The Pratt & Whitney Co., The Baldwin Locomotive Works, The Straight Line Engine Works, and others.

In conversation with one of the members of the society, he mentioned a milling machine shown to him in Scotland, having a face mill or cutter 8 feet in diameter. This machine was used to face off the ends of beams, sheets, and such work.

In the construction of machine tools it is possible to mill every part of an engine lathe, a great part with common straight cutters and the balance with special ones. Modern cutter grinding machines, with their attachments, have made it possible to keep cutters sharp and in perfect shape, so that the old and expensive methods of grinding by hand, or annealing and working over, need not be resorted to, and modern ideas of



DUPLEX PUMP.

the sizes of cutters necessary to do work make their first cost much less. A cutter of 2 inches to 2½ inches is now used where formerly it was thought necessary to use one of from 4 to 6 inches diameter.

The field of regular and special milling machines for small work being pretty well worked over, what is wanted is more special machines and fixtures, built for and adapted to the finishing of parts of such machinery and tools as are now finished on the planer.

In the shops at Flushing, Long Island, with which I was formerly connected, milling machines and special milling fixtures were adapted for nearly every part of the 14-inch swing engine lathe. The only part of this lathe not milled was the bed and a small part of the carriage, and this was under consideration when the partnership was dissolved. As to the cost of milling some of the work, without going into details, we will take the matter of the feed apron, on which there were taken 12 cuts, it being finished all over, being shaped as in Fig. 6. The entire cost of finishing this apron, 16 inches in length and 7 inches wide, was but 7 cents, with the extra advantage of each and every piece being an exact duplicate. Should there be any tool builders present, they can tell the cost of planing the apron shown.

A man employed in the shop offered to finish 6 feet 14 inch lathe beds for 60 cents each, if I would build for him a milling machine such as had been sketched out. We were at that time paying $3.00 each for planing them.

I have been informed that the Pratt & Whitney Co. are considering the feasibility of constructing a milling machine for this purpose. Should they do so, it would be safe to guarantee its practicability. The Putman Machine Co., of Fitchburg, Mass., have, acting upon my advice, made a milling fixture for an 84 inch square planer, for facing up the ends of planer and lathe beds when it is necessary to join them together. This arrangement works perfectly, the ends being milled off before the bed is removed from the planer platen. When bolted together the two pieces are as near a true plane as it is possible to make such work, while the time consumed was less than it would take to remove the bed and place it crosswise on the planer platen.

In several tool-building shops, fixtures are used for finishing the ends of lathe beds, they being bolted to the bed and run by a roundabout belt and having automatic feed. The cost for this work is but little more than the cost of attaching the fixture to the bed and removing it after the work is done.

There is hardly any limit to the devices for milling fixtures. Large shafts can be spliced when in position; key-ways cut in large fly wheels; and in locomotive construction and repairs, an immense amount of money could be saved in this way.

A large special milling machine has just been finished for use in the Straight Line Engine shops, at Syracuse, N. Y. In a communication received from the president of the company a short time since, he mentioned the fact that the machine was just completed, and he was at that time engaged in milling out the T slots for bolt ways in the platen, which was being accomplished at the rate of two inches per minute A few words from him in relation to its merits, as compared with the planer, would, no doubt, be very interesting, and also the same from the president of the Ferracute Machine Co., of Bridgeton, N. J., on an immense milling machine which they are constructing for their own use.

The advantages of the milling machine over the planer are many, among which are the following: Exact duplication of work; rapidity of production—the cutting being continuous; cost of production, as several machines can be operated by one workman, and he not a skilled mechanic; and cost of tools for producing a given amount of work.

It is not possible in a short paper to show more than a few of the advantages, but if an interest is awakened in the possibilities of the milling machine, in cheapening the cost of machine work of all descriptions, the object of this paper will be accomplished.

Dean Brothers' Duplex Pump.

The duplex pump herewith shown is the recent pattern brought out by Dean Bros., of Indianapolis, Ind. The castings are heavy, and the frame made in straight lines to prevent springing. The levers are wrought-iron forgings and the links are of brass. The plungers of water cylinder work through packing rings of brass. Access to the pump valves is obtained through hand holes of large size.

Shop Notes.

At the shops of E. E. Garvin & Co., in this city, they are quite busy, and are building a good many of their improved screw machines and milling machines. They also have the contract for building the Hammond typewriter, upon which they keep quite a number of hands employed.

They have in use one of their tapping machines, which is proving itself to be very useful. In general appearance it resembles an ordinary drill press, and instead of tapping holes by hand, the parts of machines in which holes are to be tapped are placed upon the table of this machine and tapped by power.

By this means better results are secured in the points of uniformity of sizes, squareness and economy. They are at present building, for a Western manufacturing establishment, a gang drill, to be used for drilling holes in iron pipes, which has some novel features.

It has two sets or rows of spindles, one set being vertical and the other horizontal. The spindles are adjustable as to distance from each other, and are fed automatically, both sets operating at the same time. This firm are introducing in their shops milling operations, to take the place of planing, finding it advantageous to do so, even where the milling requires more time than would be required to plane the piece. This is on account of the decreased cost of the labor required and the greater uniformity secured.

Fair of the American Institute.

Among the exhibits at the Fair of the American Institute, few are of more interest to mechanics than the process of electric welding which is on exhibition there.

By this process, which is the invention of Prof. Elihu Thomson, of Lynn, Mass., metals which it has not been found practicable to weld by heating in an ordinary fire, are united readily. Among these we mention cast-iron, brass, copper, zinc and German silver.

It is also made possible to weld metals unlike in their nature, such as iron and brass, or iron and German silver.

The process seems best adapted to cases where the articles to be welded are manufactured in large numbers, so that the apparatus may be continuously used without change for a large amount of work.

The electrical current required must be adapted to the purpose, its volume being regulated to suit the nature of the welding to be done.

The ends of the pieces to be welded are filed and suitably shaped, and are then clamped to the machine, the ends brought together by a screw motion, a flux applied,

and the current turned on. The ends immediately begin to heat, and as they soften are crowded together by the screw motion before alluded to.

The welds are made very fast, and if desired, the work may be hammered while the welding is going on.

It is well understood that as a metal becomes heated, its conducting power is decreased, which, of course, means that its resistance is increased, and in that part of a piece of metal in which the resistance is greatest, the most heat will be developed. For this reason, the work may at any stage of the process be removed temporarily, and when replaced, the further heating will be confined to the part already heated.

It is also because of this principle that remarkably even heating is secured, because the parts which are the coolest become the path for the greatest current, until the temperature is equalized.

Of course the process is a comparatively cleanly one, and we think will prove valuable in many lines of manufactures.

Practical Drawing.

BY J. G. A. MEYER.

FIFTY-FOURTH PAPER.

Problem 51.

TO FIND THE HORIZONTAL PROJECTION OF A RIGHT CYLINDER, ITS VERTICAL PROJECTION BEING GIVEN, THE AXIS OF THE CYLINDER IS PARALLEL TO THE VERTICAL, AND OBLIQUE TO THE HORIZONTAL PLANE OF PROJECTION.

The method for finding the projections of a cylinder when its axis is perpendicular to the horizontal plane of projection is given in Art. 301; and the same method for finding the vertical projection is also used for finding the vertical projection of a cylinder when its axis is parallel to the vertical plane of projection, and oblique to the horizontal plane.

Now it often happens that cylindrical bodies, when shown in connection with other bodies, must be shown in an oblique position; cases of this kind frequently occur in making general plans of machinery: it is therefore necessary to know how to find the projection, as shown in Fig. 267, of a cylinder standing in an oblique position, and the principles connected therewith.

Hereafter, for the sake of brevity, all lines which are drawn perpendicular to the ground line, we shall name vertical lines.

Fig. 268.—Let *A B* be the ground line, and *m n o p* the vertical projection of the cylinder, which has been found according to the method given in Art. 301. Let the line $c_6\ c_2$ represent the projection of an element contained in the projecting plane of the axis, or as the draftsman would say, let the line $c_6\ c$ be the center line of cylinder. Prolong the line $c_6\ c$ towards c_2. On this line mark off any point c_4 at a convenient distance from the line *m n*, so as to allow the circle $m_2\ n_2\ c_2\ d_2$ to clear the line *m n*. From the point c_4 as a center and with a radius equal to *m c* (one-half of *m n*) describe the circle $m_2\ n_2\ c_2\ d_2$. Through the center c_4 draw the diameter $m_2\ n_2$ perpendicular to $c_6\ c_2$. Divide this diameter into any number of equal parts, say six, and through the points of division $f_4\ h_4$, $j_4\ l_4$, draw lines parallel to the center line $c_6\ c_2$, cutting the circumference in the points $e_2\ f_2\ g_2\ h_2$, etc., the upper base in the points *f h*, etc., and the lower base in the points $f_6\ h_6$, etc.

At any convenient distance below the ground line *A B* and parallel to it, draw a line $o_3\ n_3$; through the points *m*, *f*, *h*, *e*, *j*, *l* and *n*, draw vertical lines, cutting the line $o_3\ n_3$ in the points $m_3, f_5, h_5, e_5, j_5, l_5$ and n_3 respectively. From the point f_5 as a center, and with a radius equal to $f_4\ f_2$, describe two short arcs cutting the vertical line in the points f_3 and e_3; from the point h_5 as a center, and with a radius equal to $h_4\ h_2$, describe two short arcs, cutting the vertical in the points h_3 and g_3; in a similar manner, make the distance between the points c_3 and d_3 equal to that between the points c_2 and d_2; $j_3\ i_3$ equal to $j_2\ i_2$ and $l_3\ k_3$ equal to $l_2\ k_2$. With the aid of one of the irregular curves shown in Figs. 128 and 129, join the points $m_3, f_3, h_3, e_3, j_3, l_3, n_3$ etc. The curve so formed will be the horizontal projection of the upper base of the cylinder. In a manner precisely similar to the foregoing, the curve o_3, d_7, c_7, p_3 is found, which is the horizontal projection of the lower base. It may be remarked that the distance between $f_7\ e_7$ is equal to that between f_2, e_2; h_7, g_7 equal to h_2, g_2, and so on; otherwise the construction for finding the horizontal projection of the lower base is plainly shown. Join the points c_3 and c_7; also the points $d_3\ d_7$ by straight lines, which will complete the horizontal projection $o_3, d_7, d_3\ \ n_3, c_3, c_7$ of the cylinders.

The straight lines $d_3\ d_7$ and $c_3\ c_7$ will be

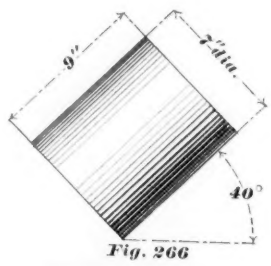


Fig. 266

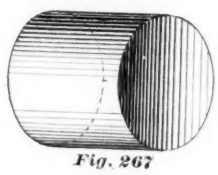


Fig. 267

tangent to the curves, and their lengths limited by the points of tangency if the curves have been correctly and accurately drawn. The portion d_7, c_7, p_3 of the lower base must be dotted, because it is hidden.

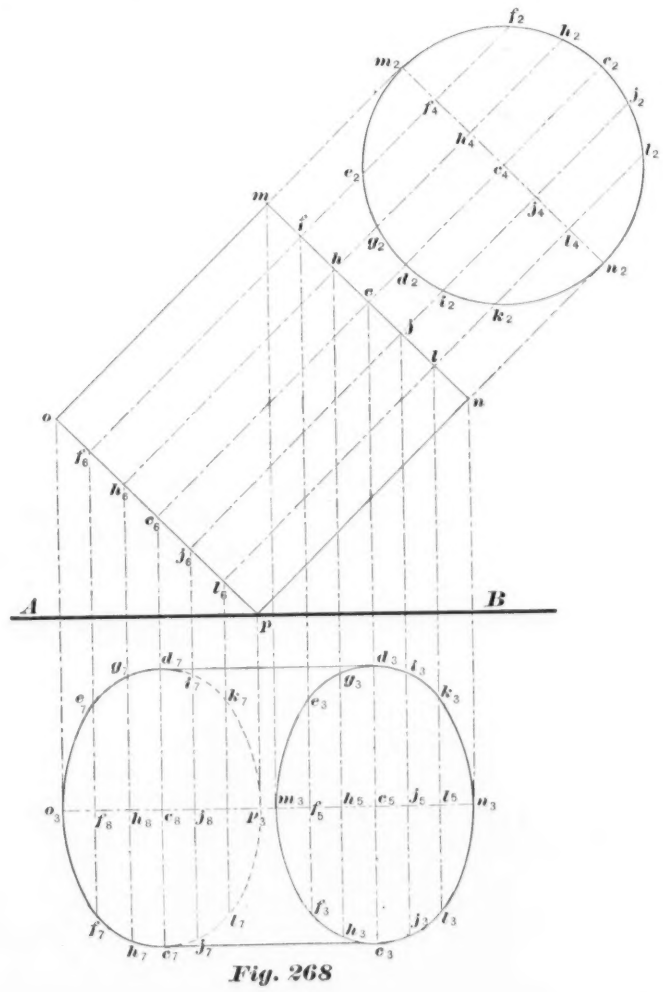


Fig. 268

This construction is based on the following principles: In the vertical projection of the cylinder the lines $m\ o, f\ f_6, h\ h_6, c\ c_6$, etc., simply represent elements (Art. 298) of the cylindrical surface, or in ordinary language, the lines *m o*, $f\ f_6$, etc., represent lines drawn on the cylindrical surface and parallel to the axis. These elements are terminated by the bases of the cylinder, hence the points *m*, *f*, *h*, *e*, etc., are the upper, and o, f_6, h_6, c_6, etc., are the lower extremities of the elements shown; these points also lie in the circumferences of the bases. By establishing a certain number of points, *m*, *f*, etc., as we have done, this problem, which at first sight may have appeared to be a difficult one, is reduced to a very simple one, for now we have only to find the horizontal projection of these points, then join these by curved lines, which will represent the boundary lines of the bases in the horizontal projection of the cylinder.

Before we can find the horizontal projections of these points, we must know the relative positions of the same to some known plane or given line. Thus for instance: We may find the distances of the points *m*, *f*, *h*, etc., from the vertical plane of projection, or we may find the distances of these points from a diameter drawn parallel to the vertical plane of projection. We will adopt the latter method, because, by doing so, the construction will be simpler and require less labor. Let us revolve the projecting plane, which contains the upper base, around its trace *m n*, until it stands parallel to the vertical plane of projection; and in this position of the plane the upper base will be represented by the circle $c_2\ d_2\ m_2\ n_2$; in fact, by turning the projecting plane with the base around the trace *m n*, we bring the base into a position in which its true bounding line—which in this case is a circle—can be seen. In turning this plane around the trace *m n*, the paths of the points *m*, *f*, *h*, *c*, etc., will be represented by lines drawn through these points perpendicular to the line *m n* (Art. 322), and since these points are also the extremities of the elements which are perpendicular to the same line *m n*, it follows that the lines $m\ m_2, f f_2, c\ c_2$, etc., which represent the paths of the points, are continuations of the lines which represent the elements, and therefore the center c_4, from which the circle has been described, must lie in the line $c\ c_2$; and the positions of the points *f*, *h*, *c*, after the projecting plane has been revolved, must be found in the line $o_3 n_3$ parallel to *A B* is drawn; the points $m_3\ n_3$, in which the verticals through *m* and *n* cut the line $o_3\ n_3$, will be the extremities of the diameter in the horizontal projections; consequently the lines $m_3\ n_3$, $m_2\ n_2$ and *m n* will all represent one and the same diameter.

We notice that the line $f\ f_2$ cuts the diameter $m_2\ n_2$ in the point f_4, and the circumference in two points, namely, f_2 and e_2. We have already seen that the point *f* represents the point f_2; it must now be added that the point *f* also represents the points f_4 and e_2, because the points f_2, f_4, e_2 lie in the same plane and in one straight line, and when this plane is turned around the line *m n* until it stands perpendicular to the vertical plane of projection, the line $f\ f_2$ will also stand perpendicular to the same plane of projection, and the three points, e_2, f_2, f_4, will be represented by the point *f*. For similar reasons, the point *h* will represent the three points $g_2\ h_2\ h_4$, and the same remarks apply to the points *c*, *j*, *l*. In Article 227 we see that the horizontal and vertical projection of a point must lie in one straight line drawn perpendicular to the ground line *A B*, and therefore the horizontal projections of the three points represented in the vertical projection by the point *f* must lie in the vertical line drawn through *f*, and since $m_3\ n_3$ is the horizontal projection of a diameter parallel to the vertical plane of projection, it follows that the point f_5, in which the vertical through *f* cuts $m_3\ n_3$ must be the horizontal projection of one of the points represented by *f*, namely f_4. The other two points, e_3 and f_3, represented by the same point *f*, must also lie in the same vertical, and their distances from the diameter $m_3\ n_3$ must be equal to the distances between the points e_2, f_2 and the diameter $m_2\ n_2$. Therefore from the point f_5 as a center, and with a radius equal to $f_4\ f_2$ or $f_4\ e_2$ (both these lines are equal in length), we describe small arcs, cutting the vertical in the points f_3 and e_3, which are two points in the boundary of the horizontal projection of the upper base. Similar reasoning is applicable to the method of finding the points h_3, j_3, c_3, etc., and also to the method of finding the horizontal projection of the lower base.

We join the points c_3 and c_7 by a straight line, because these points are the extremities of the element to which the projecting plane is tangent. The points d_3 and d_7 are the extremities of another element to which a projecting plane is tangent, and therefore the points d_3 and d_7 are joined by a straight line. Both the elements $c_3\ c_7$ and $d_3\ d_7$ are represented in the vertical projection by the line $c\ c_6$.

Directions.—In the space marked 51 draw the vertical projection of a cylinder having the dimensions given in Fig. 266, and in a position so as to make an angle of 40 degrees with the ground line as shown; then find the horizontal projection of the cylinder. By dividing the diameter $m_2\ n_2$ into a greater number of parts than shown, a greater accuracy in the horizontal projections of the bases will be obtained.

REMARKS.—A view of a cylinder as that shown in Fig. 267 or Fig. 268 has not much value as a working drawing, because the true boundaries of the bases cannot be seen, neither can we see the correct length of the cylinder. But if we have to make a plan of a horizontal engine whose cylinder is inclined, or plan of an oscillating engine, then the cylinder must be shown in a position in which a greater part of its outline is foreshortened, as represented in Fig. 267, and in cases of this kind, the method given in this problem for finding the outline is applicable and extremely useful. In our next problem we will give a practical application of this method. Of course, in general plans, construction lines are only drawn in pencil, and when the outline is inked, the construction lines are erased. But in these problems the construction lines should all be inked, so that they will be preserved for future reference, as there will often be occasion to refer to them; the time required to ink them in is short, and the exercise beneficial to the beginner.

The Improved Castle Engine.

In our issue of May 21st we published cuts showing sectional and detailed views of this engine, since which time the new form, herewith shown, has been brought out.

It has two vertical cylinders, placed side by side, the principle of its action being practically the same as the single cylinder engine, which was fully explained in our former issue spoken of above.

In this engine the wrist pins are placed 180° apart, so that, notwithstanding the fact that the engine is single acting, there is yet a constant action upon the crank shaft.

The wrist pins are placed at an angle with the crank shaft, and thus a spiral motion is imparted to the piston, by means of which the steam and exhaust ports are opened and closed.

In this way the usual valves and eccentrics and their attendant mechanisms are dispensed with, and the number of parts composing the engine very much reduced. This of course reduces the friction of the engine, since no slide valve is to be moved, and there are no stuffing boxes.

The makers state that they so arrange the various parts as to secure the best and most economical distribution of steam, that no wear can take place which affects this distribution, and that the engine cannot be tampered with so as to affect it.

Most mechanics are familiar with the fact that only a comparatively very small force is required to impart a rotary motion to a cylindrical body which is already in motion endwise, and it is, in part, owing to this circumstance that in this engine the power expended in steam distribution is reduced to a very small amount.

The reversing mechanism consists simply of a three-way cock by which steam is changed from the steam port to the exhaust port, and *vice versa*, which, it is claimed, makes it an especially desirable engine to use for hoisting purposes, or for launches or small boats where frequent reversals are necessary, and yet where it is especially desirable to secure simplicity and the least possible necessity for attendance.

The exhaust takes place at the end of the downward stroke and carries with it all water of condensation.

All other points were covered by our former description, and need not be repeated here.

The engine is made by the Castle Engine Works, Indianapolis, Ind.

Crystallization by Repeated Heatings.

Thomas Edington & Sons, of the Phœnix Iron Works, Glasgow, write to *Engineering* as follows:

SIR: We have observed the correspondence on this subject in your journal, and we think our experience may prove interesting.

In the manufacture of cast-iron pipes of small diameter, we use as core bars iron tubes made from strips of good quality; these bars are exposed to a temperature of between 600° and 700° Fahr. in the drying stoves, and again to a high temperature when the metal is poured into the mould. The result of the repeated heating and cooling is an alteration in a very short time of the structure of the iron from fibrous to crystalline. The stoves for drying the cores are heated with gas from a Wilson producer, so that in this case the change of structure can scarcely result from the presence of finely divided carbon. We find that the wrought-iron in the spindles of core bars for large pipes is affected in the same way.

Again we find that the chains, used for suspending pipes in the dipping pans, lose their fibrous structure in a comparatively short time, although the temperature of the coating mixture never exceeds 350° Fahr. Of course, while exposed to this temperature, the chains are always in a state of tension, which will vary according to the weight of the pipes.

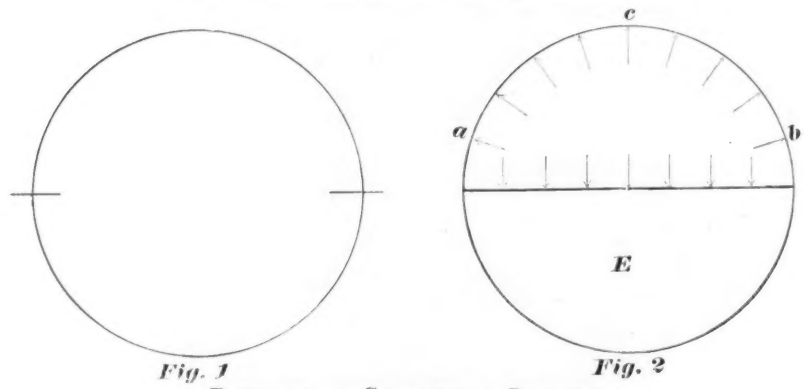


Fig. 1 *Fig. 2*

RESISTANCE OF CYLINDERS TO BURSTING.

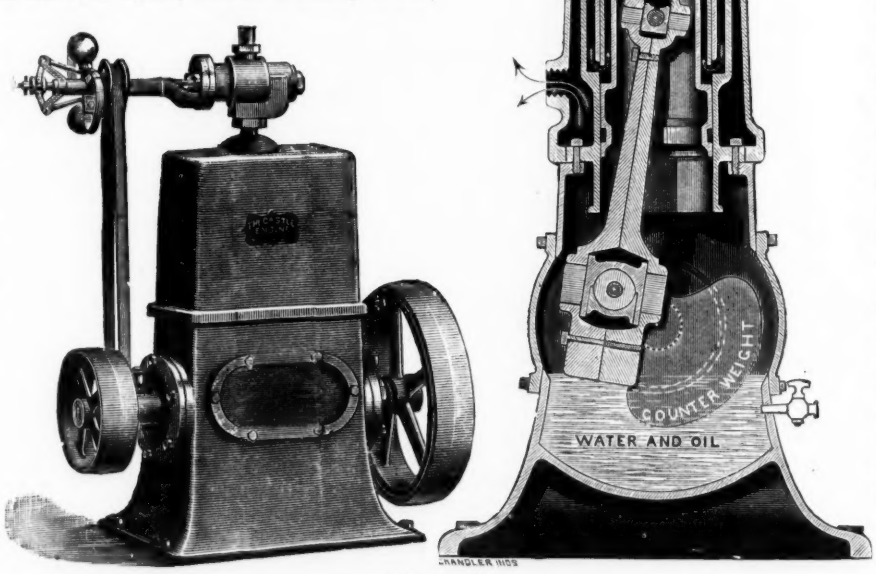
A new use for cement has been found in England in the making of telegraph poles. The poles consist of an iron shell filled up with the cement or concrete, which incloses a core of wire netting which is carried up the interior. They are claimed to be much lighter than those of cast-iron and practically indestructible.

The Resistance of Cylinders to Bursting Pressure.

BY W. H. BOOTH.

It might be thought almost unnecessary to say anything upon the method of computing the bursting strength of a cylindrical pipe, boiler or other metal, but a most remarkable example of ignorance upon the subject has just been placed on record in connection with the recent disastrous explosion of a copper steam pipe on board the English steamer Elbe. That eminent expert, David Kirkaldy, of world-wide fame and reputation in his own special line of business, has shown, before a committee appointed to inquire into the explosion and to trace its cause, that he is utterly at sea upon this important point, and however reliable he may be as an authority upon the behavior of iron and other materials under direct stress, he appears to know nothing of how to calculate mixed stresses.

Before the committee Mr. Kirkaldy explained his method of calculation, which was to multiply the circumference of the cylinder by the pressure of steam acting within it. The product would be the stress on a strip of metal $1'' \times t$, where t is the thickness of the metal in the pipe. Now, the circumference of a pipe is just about $6\frac{1}{4}$ times its semi-diameter, and the really correct way of figuring out the stress is to multiply the semi-diameter of the pipe by the pressure and the product is the stress on a strip of metal $1'' \times t$.



IMPROVED CASTLE ENGINE.

Let us figure out by both methods the case of a 9" pipe, $\frac{1}{4}''$ thick, and subject to an internal pressure of 100 pounds per square inch. By Kirkaldy's method we have the circumference $= 9'' \times 3.1416 = 28\frac{1}{4}''$, and $28\frac{1}{4} \times 100$ lbs. $= 2{,}825$ lbs. on a strip of the pipe $1'' \times \frac{1}{4}''$. Hence $2{,}825 \times 4 = 11{,}300$ lbs., as the stress per square inch on the metal of the pipe.

Now for the correct method:

The semi-diameter is $4\frac{1}{2}''$, and $4\frac{1}{2} \times 100$ lbs. $= 450$ lbs. on a strip of metal $1'' \times \frac{1}{4}''$ or 1,800 lbs. per square inch of the material. If the ultimate strength of the material be supposed as 18,000 lbs. per square inch, our pipe would have a marginal factor of 10, which is sufficient; but by the Kirkaldian method of calculation an attempted factor of 10 would really be over 60, and result in frightful extravagance. In fact, Mr. Kirkaldy's method would do very well by which to dimension pipes, if the working stress were taken fully up to the ultimate strength of the material, for we should still have a factor of $6\frac{1}{4}$.

There are doubtless others who are under misconception on this very subject, and we will try to make it clear.

In our Fig. 1 the cross-section of a pipe may be supposed. If this is burst it may tear longitudinally at any point, and we may suppose, correctly and logically, that it will as probably tear at one of the two places marked as elsewhere. If equally strong at any two places, it would tear at both of them; but some one part is certain to be the weakest, and there rupture takes place. Suppose now, in Fig. 2, that a flat central wall is built in the pipe. We may still suppose fracture would occur at the point marked.

Now, in each of these semi-cylinders the pressure is everywhere, of course, normal to the surface; for if not, motion of the contained steam would take place and it is this fact that leads the circumferential men into their error; for they say that the half circumference is more than 50 per cent. longer than the diameter, and thus carries more pressure. They forget that if the pipe ruptures at, say a, the arrows representing the steam pressure are not all square, or nearly square, to the line of rupture; arrow b, for example, having made no effort in making a tear at a, though fully effective upon section c, for example.

Thus it is that the circumferential, or rather the radial pressure lines, require reduction, as they do not all act with their full energy at any one section of the pipe. How can we prove our statement by actual experiment? Very easily. Cut away all that half of the cylinder marked E, and fill the remainder with steam or water at pressure, and then fix the semi-cylinder to end pivots upon a truck on wheels. Now, if the pressure on the semi-circumference is greater than the pressure on the flat side, what would be the result? Why the wheeled truck would move in the direction of the round side. So, we should obtain motive power for nothing, but the expense of filling a few half cylinders with water under pressure. What a giant discovery have we here? The whole world would be revolutionized; but, unfortunately for perpetual motion, the truck would remain at rest, and this would prove that at the points a and b the stress is simply that due to multiplying the diameter by the pressure, and dividing the result equally between the thickness of metal at a and b, or any other diametral section. We may express this in the shape of a rule, as follows:

To find the stress on the material of a pipe, multiply the diameter in inches by the pressure in pounds per square inch, and divide by twice the thickness of the pipe. The result is the stress per square inch of pipe.

To find the bursting strength, divide the above result into the tensile strength of the material of the pipe, and the result multiplied by the pressure above used will be the bursting pressure.

As an example, take the nine inch pipe quoted above, and 100 pounds pressure.

The stress on material

$$=\frac{9\times100}{2\times\frac{1}{4}}=1{,}800.$$

Suppose the material to be copper of 28,000 pounds tensile strength.

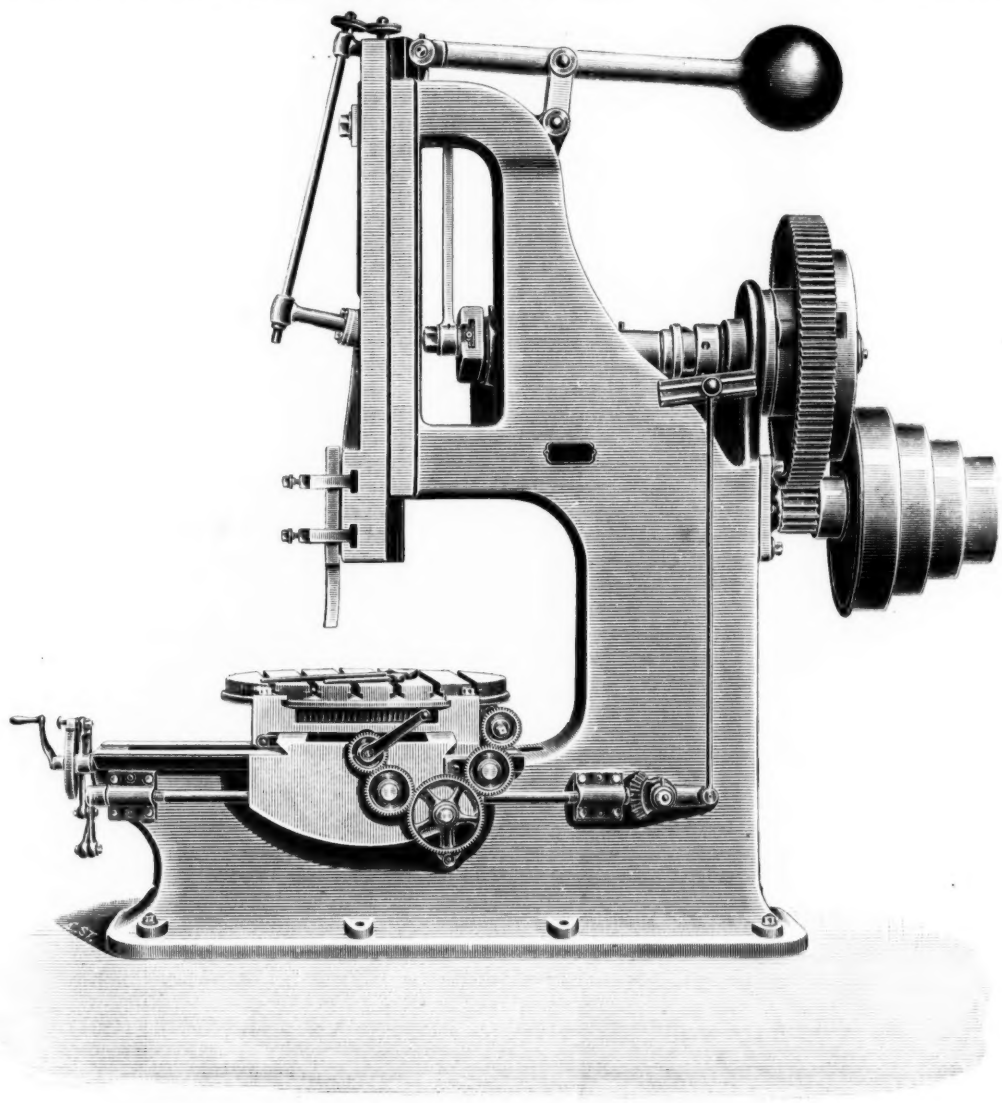
Then $(28{,}000\div1{,}800)\times100=1{,}555$ pounds pressure; so that our pipe has a nominal factor of safety of $15\frac{1}{2}$, and would be safe if made of solid drawn copper only $\frac{1}{8}$ inch thick; when its safety margin would still be $7\frac{3}{4}$. The unfortunate blunder made and persisted in by so great a man as Kirkaldy proves that a man famous on certain lines of work should enter cautiously on fields outside his own peculiar province. Mr. Kirkaldy is doubtless unequaled in conducting tests, but clearly not ready in applying his results to machinery, and his error in this in no way detracts from his record and ability in the line of work wherein he is a specialist.

Thirteen-Inch Slotting Machine.

The frame of this machine is wide and of ample proportions to secure stability and to prevent spring. The ram is driven by a four-speed cone and spur gearing. The Whitworth quick return gives a rapid up stroke and a slow cutting speed to the ram. The stroke may be varied from 0 to 13 inches, the change being quickly made by the screw on the crank disk, and the position of the ram with regard to the work may be quickly changed also by means of the rod shown on the front of the ram. The counterbalance takes up the lost motion in the pin.

The work is fastened to a circular table, which is driven by a worm wheel and gear and which is carried on compound tables having longitudinal and transverse motions. All three tables have self-acting feeds in both directions, the feed taking place at the beginning of the stroke and never during the cut. The feeds may be varied from 0 to $\frac{7}{16}$ of an inch. The circular table may be clamped to the compound table. All the handles are within easy reach of the workman. This is an important feature, as work on the latter demands constant attention from the workman, and he should be able to operate all the feeds without stopping the machine.

All the wearing surfaces are broad, and scraped to a perfect bearing. All wearing screws and spindles are of steel; countershaft and wrenches included with machine. Following are some of the principal sizes: Large step of cone, 20″ by $3\frac{3}{4}$″ face; ratio of gearing, 1 to 4; circular table, 3 feet in diameter; compound table feeds, 21″ longitudinally and $27\frac{3}{4}$″ across; machine will slot to center of 57 inches; distance from tool rest to inside of frame, 27 inches; from circular table to frame, 19 inches; length of ram, 4′ 4″. The manufacturers are the Newark Machine Tool Works, East Newark, N. J.



THIRTEEN-INCH SLOTTING MACHINE.

The latest candidate for favor in the steam engine line is a four-cylinder affair that exhausts back into the boiler, or is said to do so. The saving is to be fifty per cent. of floor space, and seventy-five per cent. of fuel. There are "no valves, eccentrics, steam-chests, cut-offs link motions, etc., to get out of order," and it has various other advantages, but as they do not save more than a paltry twenty-five to thirty per cent. of anything they are hardly worth enumerating.

The above claims look like absurdities, but as a drawing has been exhibited to the chamber of commerce in one city, and is to be exhibited on the New York Stock Exchange, and a company has been formed with a capital of $500,000, we are forced to believe that—the gullible had better look out for their money!—*The Locomotive.*

LETTERS FROM PRACTICAL MEN.

Examination of Locomotive Engineers

Editor American Machinist:

Various articles have appeared of late in the AMERICAN MACHINIST relating to examinations of engineers' license laws, and methods of promotion. Now, as regards examinations, any reliable engineer could not object to that where necessary, and employers of engineers would be serving their own interests by having such examinations made in many instances.

Examinations as to mechanical knowledge and ability to take charge of a steam engine is more necessary in some cases than in others. Take, for instance, a marine engineer, or one in charge of the steam plant in a large mill or manufacturing establishment. Frequently the owner has not the necessary mechanical knowledge to judge of the fitness of an applicant, and frequently the duties are of a purely mechanical nature, where any mishap to the machinery is fraught with serious danger, delay, and large expense; also loss of time to owners and workmen. In such cases license law requiring an examination of the general mechanical information of an applicant might be the best method of providing engineers for such positions. But it is somewhat different as regards locomotive engineers. If your engine breaks down during the trip the road does not shut down on that account. Another engine usually is quickly provided to take the place of the disabled one, and continue the trip, and usually the cost for repairs to the disabled one is not high.

Railroad mechanical officers, as a rule, do not bestow as much attention on rigid mechanical examinations to discover how much technical knowledge is possessed by the candidate as upon some other qualifications necessary in a locomotive runner, and such questions as are asked by many able officials tend most to discover the good sense, judgment, etc., of the man.

It is often taken for granted that if a man has fired four or five years for some of the most successful engineers on the road, that he will not need much instruction in caring for an engine, and if he has sufficient knowledge of the methods of conducting railroad traffic, and comes up to certain other requirements in other respects, he is promoted. A man who has fired a locomotive four or five years (and with few exceptions no one should be promoted who has not served an apprenticeship at the shovel of four years), and has given satisfaction during that period by honest, faithful service, has surely learned the duties of a locomotive engineer and the proper care of a locomotive if he is ambitious and intelligent.

Mechanical officers and others in charge over engineers and firemen on railroads, are qualified in most cases to intelligently judge of the ability of those under their supervision, and if those who are associated with the men continually, sometimes fail in their selections, what could be expected of a license law in supplying reliable engineers for them? A certificate would not make a reliable man out of a drunkard, nor a careful one out of a reckless one; neither would it be a guarantee that a man could get along on time, or keep out of trouble on the trips; neither would such license tell whether the man knew how to run a locomotive or not. It would merely show that he was glib enough to answer the questions propounded, but as a locomotive engineer in actual service, he might prove a dismal failure, and that, while he had sufficient mechanical information to answer all the questions, still there were a thousand and one points about the business that he could not answer, unless he obtained his information in actual service on the deck plate of a locomotive.

Any law rating the mechanical knowledge of locomotive engineers is, from the nature of their occupation, unnecessary, and could not be otherwise than pernicious, both in its methods of application and in its effects—a snare lulling the public into a false security.

On well regulated roads to-day boilers are examined and overhauled periodically, and watched carefully. Certain methods of tests are applied to them, certain steam pressure only is permitted, and railroad companies have men employed as road foremen of engines. And besides, if an engineer is in doubt as regards any point, he has only to ask, and he will find engineers of extended experience who can give him reliable and practical information. The old "chestnut" about "know-all" engineers is about worn out; for if a man starts out to run a locomotive with such ideas, it will not be long before he gets disabused of such notions, or until he will be in need of a job. J. J. CLAIR.

Pittsburgh, Pa.

The Spring Roller Problem.

Editor American Machinist:

Prof. Sweet's problem is a very interesting and profitable one. There are two distinct classes of mechanics and designers: one class work from mathematics and the other from practical experience. There is a dangerous extreme in both directions. Most works on mechanics and strength of materials are practically useless to one who is not well up in the applications of the calculus. This fact leads to a general prejudice against results obtained by its use. On the other hand, for the average mechanic life is too short to follow the method laid out by Mr. Coffin. A man of his skill and experience in handling steel might do it rapidly and well, but the ordinary machinist is rarely confronted with problems on strength of materials, and, consequently, is at a loss when such a problem arises.

Every well-educated machinist ought to know something of the practical data on which our knowledge of steel and iron rests. If some one could write a book in simple language, free from mathematical technicalities and explain where the back-bone of all our definite knowledge begins, it would tend considerably to a better understanding between mathematicians and practical men. Each can be of great service to the other.

In the case of Prof. Sweet's problem, I think Mr. Begtrup would get his roller proportioned sooner than Mr. Coffin would. A good formula, with sound experiment to clothe it, is invaluable. The most profitable thing to be done in this particular case, it seems to me, is to adopt some formula, and when experiment has shown that it gives correct results, retain it for use. If it gives too high or too low results, introduce some simple factor that will bring the formula into correct shape.

In conclusion, I would like to propose the following as a possible formula. It gives somewhat higher results than either Mr. Noble's or Mr. Begtrup's. It is substantially Trautwine's formula, with constants determined by experiment. The formula is:

$$d=\sqrt[3]{\frac{l\,s^3}{b\,D}\,c}$$

where l = load, s = span in feet, b = breadth in inches, d = depth in inches, D = deflection in inches, and c = a constant, in this case .000010. This formula gives .1474″ as the thickness of the rings.

J. TORREY.

Exhaust Heating.

Editor American Machinist:

The recent communications in your columns on the subject of exhaust heating, prompt me to send you the enclosed sketch (page 6) of the plan of piping adopted at the works of the Rand Drill Co. While the plan has been entirely satisfactory in all respects, the particular merit clamed is the practical elimination of back pressure. This is accomplished by so arranging the branch pipes which supply the coils with steam that the combined area of all the pipes of all the coils is available as exhaust pipe area; that is, the steam is not carried through

several coils in succession, but each coil receives and exhausts its own independent supply of steam. With this plan, each added coil adds to the exhaust area and to the freedom of exhaust, and it follows, somewhat paradoxically, that the more coils there are to heat, the better the results. In many cases this principle of combining the areas is so far lost sight of that I have even seen return bend coils used with exhaust steam, in which the exhaust area for each coil is that of a single pipe only, and the resistance of perhaps a dozen return bends is introduced, entirely unnecessarily. Of course, only manifold coils should be used, as with them the exhaust area for each coil is the sum of the areas of all the pipes in the coil. Of course the arrangement of the main pipes must be adapted to each particular case, but the principle is of general application. The sketch shows the general arrangement in our case. Two crosses are introduced into the main exhaust pipe, to which are secured the pipes which lead to the coils. In two cases, as shown, these pipes again divide by a tee—the principle remaining, however, that each coil shall furnish an independent exhaust passage. In the plan shown, the total exhaust area through the coils is over six times the area of the direct exhaust pipe; and this is obtained without any extravagance in the size of pipe used (the coils being composed of $1\frac{1}{4}$" pipe), but simply through the virtue of the arrangement described. With this proportion, it is easy to see why the back pressure should be inappreciable.

When taking the only indicator cards that I have so far taken, a sixty pound indicator spring was the only one at hand. With this, the back pressure due to the coils could not be detected; there was no perceptible difference between the cards taken when exhausting free and when exhausting through the coils. With a lighter spring, the difference might have been noticeable, but it could not be very serious when its existence could not be detected with the sixty pound spring.

An additional advantage of the arrangement is that, the coils being independent of one another, a portion of them can be closed off to suit various states of the weather, thereby obviating that overheated condition that usually obtains with steam heat in moderate weather. With such an amount of exhaust area as stated above, some of it can be spared without serious harm.

When laying out this pipe, I had some fears that the steam might select the coil which should offer the most direct passage, and so leave the others literally "in the cold." To provide for this, a valve was placed in the outlet of each coil, with the intention of partially closing the one belonging to the favored coil, and so equalizing the resistance and dividing the steam. No such tendency developed itself, however, and these valves have never been used.

In many cases the engine furnishes much more steam than is needed for heating, and in such cases it is usual to place a back pressure valve in the exhaust pipe, loaded to, say, two pounds. My plan in such a case would be, to use a gate valve instead of the back pressure valve, and partially close it until the steam should appear at the coil outlets, the surplus steam escaping by the usual way. It is my belief that any ordinary shop can be heated with one-half pound extra back pressure, just as well as with more.

An excellent rule for the inclination of the pipes, is to allow a fall of one-half inch for each ten feet run.

It goes without saying that gate valves only should be used in a system of pipes for exhaust steam.

FREDERIC A. HALSEY.

Primary Batteries for Illuminating Purposes.

At a recent meeting of the Society of Engineers, at Westminster, England, Perry F. Nursey read a long paper on this subject. The author took the ground that there was abundant room for electric lighting by primary batteries in houses, owing to the costliness of steam-driven dynamos. He then described several primary batteries, some of which had proved successful in mansions and large buildings; but it had not been demonstrated that any of these batteries were suited for economical use in lighting the principal rooms in more modest dwellings. Cheapness and efficiency were required. There were merits in all the systems, and a fusion of interests might be desirable, out of which should come something that would meet the requirements of the general public.

The Eighth Annual Meeting of the American Society of Mechanical Engineers.

The first session of the eighth annual meeting of the American Society of Mechanical Engineers began on Monday evening, November 28th, at the Continental Hotel, Philadelphia, Pa. President George H. Babcock read the annual address, the subject being "The Engineer: His Commission and Achievements." The following notes are a few abstracts.

The eighth annual meeting of the society opens under auspicious circumstances. This society, which less than eight years ago was small and weak as a child just come into life, has leaped into vigorous manhood in so short a space of time that it seems almost to have sprung full fledged from the brains of its founders, even as the fabled Athena from the head of Zeuss; and possibly there is more in this comparison than at first sight appears. This society, but lately only a conception in the brains of a few engineers, has now attained a membership of over eight hundred, among whom are more mechanical engineers than the whole world could have mustered a hundred years ago. This is a cause of congratulation, but it is only one of the reasons why we meet here to-night under such auspicious circumstances. Another is, that the character of the work done by the society is improving year by year, while its transactions are being sought for by similar societies in different parts of the world. As mechanical engineers, we may perhaps be pardoned if we inquire what relation we bear to what has been done, and what remains to be done, in the line of the world's progress. As very truthfully said at a preliminary meeting for the organization of this society, by one we delight to honor, A. L. Holley, the profession of the mechanical engineer underlies all forms of engineering, as well as architecture, manufactures and commerce, while science is even dependent upon it for the means of progress.

The civil engineer may plan railroads with their bridges, tunnels, cuttings and embankments, or lay out cities and waterways, but he cannot execute nor equip them without the mechanical engineer. Neither can the mining, electrical, marine or hydraulic engineer get along without calling in the assistance of his brother who deals mainly with dynamics. But the mechanical engineer's profession is not only the most important, it is also the oldest art or profession on the face of the earth, excepting agricultural, if the latter we may call a profession. Already man has dug deep and made grand discoveries of hidden treasures, such as iron, copper, gold, and about fifty other metals, coal, salt, etc., and a hundred other minerals, besides gems of untold value. From this the mechanical engineer has constructed wondrous constructions, and for them discovered various uses, all of which have contributed to the elevation and happiness of the race.

See what the engineer has wrought with the one metal, iron. It enters in nearly every construction, from that of a nail, fastening the wooden box, to the almost living locomotive, rushing with rapid speed of the storm-wind along the iron ways with which the engineer has imprisoned the earth as in a net. From it he constructs the larger part of the machines with which he supplants and surpasses manual labor. He draws it into wire and stretches it around the globe, that the ends of the earth may be brought together, and with the same wire he builds a marriage tie between cities, which rushing waters strive in vain to separate. With it makes cooking utensils, steam boilers, and, according to the latest reports, there are afloat 10,000 steamships, of which 9,000 are built of iron and steel; 350,000 miles of railroad, and nearly one-half of this amount in the United States. With the minerals the engineer has also supplied many needs and luxuries of man. There is coal, for example; the 400,000,000 tons in round numbers annually mined, give life, warmth and power. The manner of using petroleum has also kept up with the march of progress. The engineer has overcome the obstacles of the earth, and opened pathways of commerce. Electricity has also accomplished wonders. That discoveries will be still more wonderful in the future are evidenced by the fact that of fifty metals known, but eighteen are at present, and twelve of these but recently, used in the mechanic arts. Outside of that, however, there are immense fields for mechanical conquests. Waste is going on all around us in the great forces of nature. We are called upon to devise methods to store up the heat of the sun. If we can in the future utilize heat as fully in thermo-electric power as now in ordinary boilers, and in addition, when the radial heat of the sun can be manufactured into electrical force we will have reached the time when machinery will run at very little or no cost outside of the interest, wear and tear. The society must be a factor in such results. Its every meaning is to mingle experiences, to discuss causes and to extend research. The mission of the mechanical engineer is to subjugate all natural forces and elements.

At the conclusion of the president's address, Prof. John E. Sweet read a paper (published in full in our last week's issue) on "A New Principle in Steam Piston Packing." The discussion which followed was very brief, and although no one seemed to disagree with the author, it seemed that the members were not ready to pass opinions upon the packing until more experience with it had been obtained. In connection with this subject, some of the members asked for the reason of steam cylinders wearing more in the center than at the ends. President George H. Babcock closed the discussion by saying that he found many cylinders had worn more at the ends than at the center, and the probable reason why some of the members thought that cylinders did wear more at the center was, that they measured too close to the end. If they had measured the diameter a few inches away from the end they might possibly have discovered that the cylinders had worn more at the ends than in the center.

The second session was held on Tuesday morning, Nov. 29, at the same place. Several reports were read. Among these was one from Treasurer Wm. H. Wiley, showing that the year's receipts amounted to $10,586.20, and the expenses $10,413.03. A report from the committee having charge of the ballots announced that the following officers had been elected for the ensuing year: President, Horace See, of Philadelphia; vice-presidents, W. S. G. Baker, Baltimore, Md.; Henry C. Morris, of Philadelphia, and C. J. H. Woodbury, Boston, Mass.; treasurer, William H. Wiley, of New York; managers, Stephen W. Baldwin, New York; Frederick Grinnell, Providence, R. I., and Morris Sellers, Chicago, Ill.

It was also announced by F. R. Hutton, that the next meeting of the Mechanical Engineers would take place at Nashville, Tenn.

Following are abstracts of a few of the papers presented:

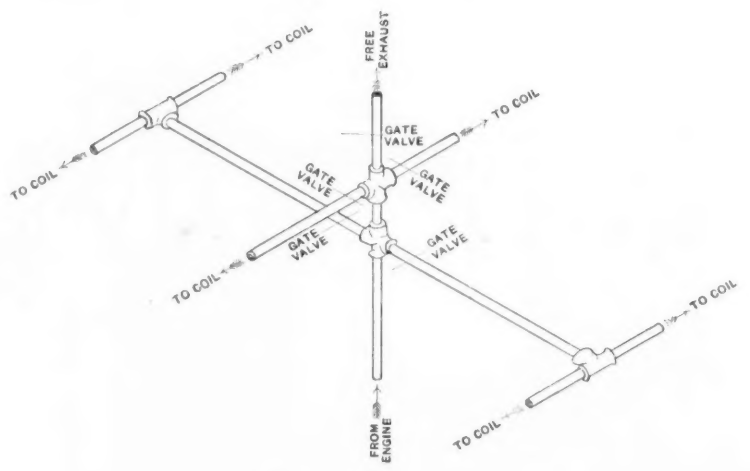
INTERNAL FRICTION OF NON-CONDENSING ENGINES.

Prof. R. H. Thurston presented a paper with the above title, in which were tabulated a number of experiments. The paper was in a sense a continuation of the subject as previously presented to the society by the author. Following are the conclusions arrived at:

1. The conclusion derived by study of the above is evidently that the internal friction of an engine of this class, operated under the conditions here described, with a constant speed secured by the action of a throttling governor, is sensibly constant for all loads, and that the variations occurring at the points of connection in the train transmitting the work of the engine, when the power varies, form too small a proportion of the total friction to have important or sensible effect on the total, or to be observed in presence of other usual causes of irregularity.

2. The conclusion reached by a comparison of the results of this investigation with those which have preceded is as obviously that the internal friction of this class of engine (the non-condensing) is sensibly independent of the magnitude of the load and of the power developed; but that it is variable with speed and with efficiency of lubrication in a very observable degree.

3. In the engine here used, the total friction was considerably less than in that employed in the investigation last reported, probably in consequence of its having been longer in service, and its bearing having thus come to a better condition. We may thus readily find here confirmation of a fact well known to engineers of experience, that the operation of a well-cared-for engine will continuously, and for a long time, appreciably reduce the internal friction of the machine.



EXHAUST HEATING.

CENTRIFUGAL PUMPS AND THEIR EFFICIENCIES.

In this paper, presented by Wm. O. Webber, the results of several tests are detailed for reference, an efficiency of from 50 to 64 per cent. having been obtained. Then the author says:

Mr. Parsons deduces some very valuable facts in relation to centrifugal pumps, which may be briefly stated as follows:

1. There are two totally different conditions in which a centrifugal pump may be situated while it is rotating. One, in which it is revolving just fast enough to raise the water up to the discharge pipe, and no further; and another in which it is revolving slightly faster, and discharging water out of this pipe. In the first case there is only centrifugal force, which is produced by the water in the fan rotating, that maintains the column of water in the discharge pipe.

In the second case this force is still produced, but in addition to it another, which may be called the force of impact, or in other words, the force with which the blades of the fan impinge against the water discharged by the pump.

2. That a fan when rotating will support a column of water, the velocity due to whose height is equal to the tangential velocity of the circumference of the fan.

3. That the internal angles of the blades vary both with the lift and discharge with which the pump is intended to work.

4. That the pump should be so proportioned in its passages as to have a gradually

increasing velocity in the water until it arrives at the circumference of the disk or fan, and then to have a gradually decreasing velocity until it issues from the discharge pipe.

This condition is obtained by having a conical or tapering suction pipe, a spiral casing surrounding the fan, a proper amount of "whirlpool" space in which to eliminate the "eddies" produced by the ends of the blades of fans, and a tapering or conical discharge pipe. And lastly, that the tangential velocity of the fluid being pumped, on leaving the fan or disk, should not be more than from 24 to 30 feet per second.

THE USE OF KEROSENE OIL IN STEAM BOILERS.

In this paper the author, L. F. Lyne, gives his experience in the use of kerosene oil in steam boilers at the Jersey City Electric Light Company's station. There was trouble with scale in these boilers, and after some experimental work the following plan was followed:

We then adopted a rule of one quart of kerosene oil per day for each of the 100 horse-power boilers, and three pints for the 155 horse-power boiler. The water is blown down two gauges every week and the entire contents every month. Water is never used to wash them out, nor is a scraper necessary; for the mud all goes out with the water. An examination is made of the interior and we put them to work again. This is a wonderful relief to us, for the reason that no scale forms in any of our boilers, and the corrosive action mentioned as having existed at first, has entirely ceased.

Another thing worthy of special notice is, that it was impossible to keep a glass water tube in use more than three months at a time, and oftentimes they would break within two months. Before using kerosene these tubes would become badly grooved and eaten away at the upper ends, so that they would break. Our engineer came very near losing his eyesight through the breaking of one of these glasses, and his face was badly disfigured by being cut with the broken glass. Now these tubes do not show any such action, and they have been in use more than a year.

I admit that rubber packing and kerosene oil do not agree, so to guard against any trouble from that source, I had new nuts one and one half inches deep placed at the ends of the glass tubes, and used asbestos wicking dipped in boiled oil, and then squeezed dry, for packing They do not leak, and these joints are permanent.

* * * In conclusion, I desire to say that crude petroleum has, to my certain knowledge, been used in steam boilers during the past eleven years and upwards, where, with judicious application, it has been successful in removing and preventing scale. While this is admitted, I must also acknowledge that great damage to boilers has resulted by not observing the necessary precautions in the quantity put into the boiler each time. I will mention but one instance, which is that of a tug-boat now running in New York harbor. The boiler was badly scaled, and some one advised the engineer to use crude petroleum; so he "*gave the boiler a good dose*," as he said. In a few days the tubes began to leak, and the crown-sheet bagged down. The boat was then laid up, when it was found that the heavy oil had mixed with the mud and had formed a paste on the crown-sheet. This paste kept the water from reaching the plates, hence the result stated above. This paste was so dense that water from a hose would not dislodge it; and I do not hesitate to say that, had kerosene oil been used in this instance, instead of crude petroleum, the boiler would not have been injured. The reason is that there is not sufficient body in kerosene oil to form a paste. The chief objection to crude petroleum is that it is too heavy, while in kerosene oil there is no substance which will stick fast to the interior of a boiler. * * * Our boilers do not lift their water, they are free from scale, and our fuel bill is thereby greatly reduced.

NOTES ON RESULTS OBTAINED FROM STEEL TESTED SHORTLY AFTER ROLLING.

This paper, presented by Edgar C. Felton, deals with the following observation:

Two years or more ago, some interesting facts were noticed in connection with certain tests then being made by the Pennsylvania Steel Company on structural steels for a well known bridge across the Ohio River. These facts were as follows: The inspector employed by the bridge company for whom the work was being done, being in a great hurry to leave our works, had tested several heats on the same day that the test bars had been rolled, and had rejected each heat so tested; the cause of rejection in each case being a low percentage of reduction of area. Several days later, pieces cut from the same bars were tested and found to fill the requirements of the same specifications perfectly, the percentage of reduction of area in the last test pieces broken being much higher than in those broken on the same day that the bar was rolled. Here was evidently something worth investigating. Knowing the very misleading conclusions which can be obtained by reasoning from an insufficient number of experiments, where the conditions are as complicated and variable as in the making of a steel bar, it seemed best to get as large an accumulation of data as possible together, and then endeavor to read their story and deduce a theory which would explain what they told. Accordingly, at such times as it has been possible during the past two years, experiments have been carried on by testing bars of steel immediately after rolling, and again after several days have elapsed, and the data so accumulated are now thought to be sufficient to arrange and discuss intelligently.

As a result of a large number of experiments the author concludes:

To sum up: The tests made upon the three-quarter inch round bars seem to prove quite conclusively that after rolling, steel increases in percentage of reduction of area, in percentage of elongation and in ultimate strength, and decreases in elastic limit. I have endeavored to account for these changes by supposing that the rough mechanical treatment of the metal by the rolls has temporarily weakened the hold of its molecules upon each other, and that this hold is regained when the metal is allowed to rest.

STANDARD SECTION LINING.

This subject was presented by Frank Van Vleck. The argument of the author was for standard practice in respect to section lining, to represent various kinds of material. The subject was presented, with illustrations, in our issue of April 9, 1887.

The Brussels International Convention and Exhibition.

This exhibition, which opens May 3, 1888, is for a twofold purpose. We quote from the rules and by-laws sent us by Armstrong, Knauer & Co., 822 Broadway, New York, who are the agents in this country, as follows: "The object of the great international competition of sciences and industry is: First, the organization of a competition between the industrial products of all countries, with prizes allotted to those who have discovered, after following a complete given formula, the greatest usefulness of matter as to science and economy. Second, the organization of a universal international exhibition, to which are admitted all products of commerce, industry, agriculture and horticulture, as in preceding exhibitions."

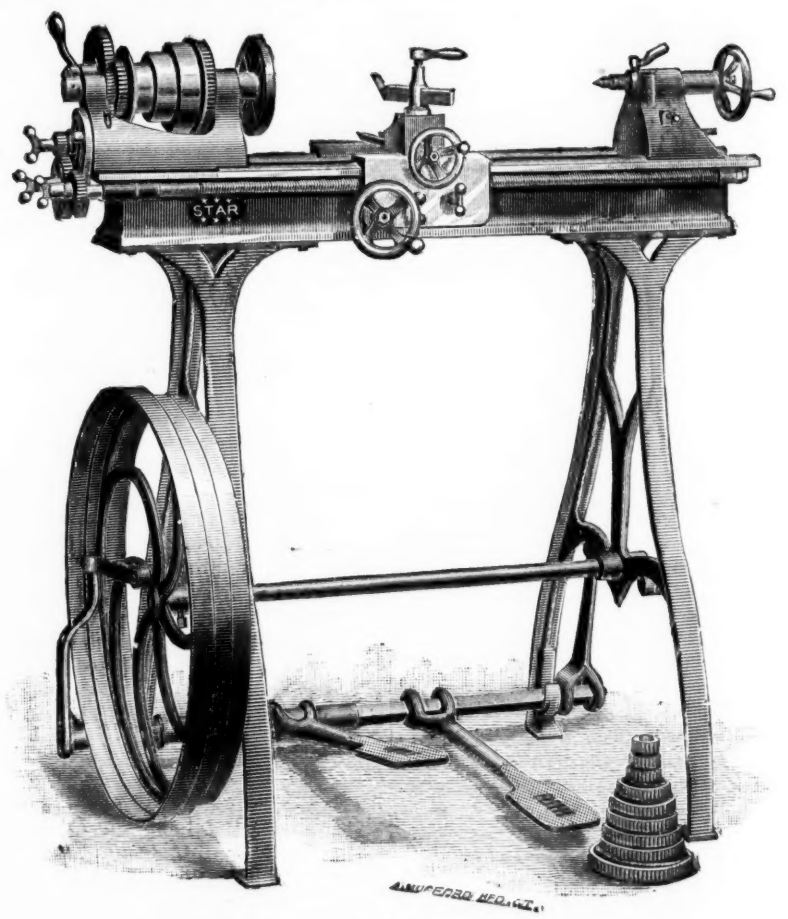
All applications from the United States for space must be made before January 15, and all entries must be made by April 15, and must be in place by April 25.

"Star" Screw Cutting Engine Lathe.

The illustration on this page shows a new foot lathe, made by the Seneca Falls Manufacturing Co., of Seneca Falls, N. Y.

It swings 9 inches over the bed, 5½ inches over the carriage, and takes 25 inches between centers. It is back geared and has an automatic cross feed. The spindle is of steel, 1¼ inches in diameter, and has a ⅜ in. hole through it, the boxes being adjustable for wear, and lined with anti-friction metal.

The carriage is substantially gibbed to the rest, and is so made as to admit of the use of milling or other fixtures, if desired. A friction feed is provided for turning, which is reversible by the movement of a lever. It will cut screws, either right or left hand, from 3 to 64 per inch, without compounding, and can be compounded for other pitches. All gears are cut from solid metal by improved automatic machinery and will run smoothly.



"STAR" SCREW CUTTING ENGINE LATHE.

The foot power is of entirely new design The treadles work independently of each other, are movable lengthwise, each being connected at opposite ends of the driving-wheel shaft in such a manner as to produce a strong, positive, and continuous motion, and may be operated with both feet, sitting, or with one foot, standing, as desired.

A countershaft is furnished, in place of the foot-power motion, if desired.

In a lengthy paper, read by Capt. Rogers Birni, Jr., before the Military Service Institution at Governor's Island, the author, after a historical review of gun making in this country, concluded that guns made from steel castings were but little better than those of cast-iron, and that the only material fit for use for large guns was forged steel.

A new system of building houses of steel plates is being introduced by M. Danly, manager of the Societe des Forges de Chateleneau. It has been found that corrugated sheets, only a millimeter (.0394") in thickness, are sufficiently strong for building houses several stories high, and the material used allows of architectural ornamentation. The plates used are of the finest quality, and as they are galvanized after they have been cut to the sizes and shapes required, no portion is left exposed to the action of the atmosphere. Houses so constructed are very sanitary, and the necessary ventilating and heating arrangements can readily be carried out.—*Industries.*

The Practical Mechanics' Institute of Poughkeepsie.

Not long since, we referred to the formation of an educational association of mechanics and engineers at Poughkeepsie, N. Y. Our correspondent, F. H. Treacy, of that place, writes us in reference to this association:

"The Practical Mechanics' Institute," recently started in this city, is meeting with good success. The membership is increasing, and a good, healthy interest is taken by the members at the meetings each week. We are now installed in our own quarters, which, although rather plain and unpretentious, answer very well until the state of our finances permit something better. At present our meetings are devoted to the discussion of some subject which has been decided upon at a previous meeting; this arrangement gives each one time to prepare himself. Any member may ask for information on any question relating to the different trades embraced by the Institute, during the time set apart for such questions. The idea is this: Suppose one of the members has had trouble with a job; he can at the next meeting state his case and receive the opinions and ideas of the other members who are familiar with the branch he is engaged in. The society admits to membership, engineers, marine and steam; machinists, moulders, pattern makers, and millwrights. The cost of membership has been made as low as possible, in order to give those who are serving an apprenticeship at any of the above trades a chance to join without seriously feeling it.

Wanted—Information About Mutual Benefit Associations.

We give place to the following letter, in hopes that it may bring information beyond that which we are able to give. We shall be glad to hear of the workings of mutual benefit societies, unconnected with other associations:

Publishers American Machinist, New York City:

GENTLEMEN—Our workmen are moving in the matter of establishing a mutual benefit society amongst themselves, and we are desirous of giving them all the assistance we can. To this end, we will appreciate it if you will give us any suggestions that may occur to you in this connection, or send us plans of any such association of which you may be cognizant.

Yours very truly,
ATLAS ENGINE WORKS.

An example of the rage to start new companies upon a small basis of success is seen in the instance of the investment in the Gobeic iron range, in Michigan. Money flowed like water into the companies organized to operate here, and in less than a year hundreds of thousands of dollars of the stock could be bought for anything offered.

Under the heading, "Co-operation between Railroads and the Navy," the *Springfield Union* says: "As soon as we get over the rush, we are going to invent a big navy gun that will throw deadly car stoves into the enemy's vessels. Two grand results will be accomplished. The enemy will be annihilated in a particularly melancholy manner, and we shall get rid of the car stoves."

Wherever our manufacturers have obtained and held foreign trade, they have done it by virtue of furnishing the articles wanted, without reference to their own prejudices in the matter; sometimes they have failed because they have assumed to know the wants of their customers better than the customers themselves. It has taken British manufacturers years to learn that buyers had rights in the way of deciding what they should buy, and it has cost them a good deal of trade, even in British provinces. As American manufacturers reach out after a foreign outlet for their goods, they should profit by the mistakes of others. Because certain lines of goods are in demand here there is no evidence that they will satisfy the demand in some other locality. And this is especially true of machinery. Nothing but an intimate knowledge of a people and their surroundings will enable a manufacturer to offer them what they want.

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Special Announcements.

☞ *Positively we will neither publish anything in our reading columns for pay or in consideration of advertising patronage. Those who wish to recommend their wares to our readers can do so as fully as they choose in our advertising columns, but our editorial opinions are not for sale. We give no premiums to secure either subscribers or advertisers.*

☞ *Every correspondent, in order to insure attention, should give his full name and address, not for publication, but as a guarantee of good faith.*

☞ *We are not engaged in procuring patent rights, or in selling machinery, nor have we any pet scheme to advance, or hobby to ride.*

☞ *We invite correspondence from practical machinists, engineers, inventors, draftsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

☞ *Subscribers can have the mailing address of their paper changed as often as they desire. Send both old and new addresses. Those who fail to receive their papers promptly will please notify us at once.*

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$3.50 a year to Other Countries, postage prepaid.

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"Business Specials," 50c. a line.

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NEW YORK, DECEMBER 17, 1887.

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Photographing Machinery.

It is generally conceded by photographers that one of the most difficult objects to make a satisfactory photograph of, is a piece of machinery.

The reason for this is quite apparent upon a little consideration, and lies in the fact that machinery almost always consists of parts which are unfinished, and painted a dark color, so that they reflect very little light, while other parts are brightly finished, and often polished, so as to reflect about all the light which falls upon them. The result is, that when a negative is exposed long enough to bring out the dark parts of the machine distinctly, the exposure is entirely too long for the finished parts, and if, on the other hand, the exposure is timed for the bright parts, the darker portions are usually represented by black patches which show absolutely nothing of form or construction.

A great many photographs of machinery come to this office, and many of them show that efforts have been made to overcome this difficulty. Among other methods, lamps with reflectors are placed so as to illuminate the dark portions.

This makes the machine itself look about right to the eye; but since no artificial light, except the electric light, has any effect upon a photographic negative, it will be seen that such a plan can be of no benefit, and the results show that it is not.

There is a plan not generally known, which always produces satisfactory results, and that is to paint the machine all over; using for the finished parts a paint mixed with any oil which will not readily harden or dry out, so that after the negative is taken, the paint may readily be wiped off.

It will be seen that by this means all parts of the machine can be made to reflect light equally.

It is a good idea, also, to have several different shades of this paint, and after the first exposure, any parts which do not come out sufficiently may be painted lighter, while those which are too light may be painted darker, and thus, by a few experiments, a perfectly satisfactory negative may be obtained.

This is a matter of considerable importance to many manufacturers and mechanics, whether they make photographs to send to prospective customers or whether they are taken for engravers to work from, and the method indicated above has been used enough to prove that it is of great practical value.

A Wonderful Locomotive.

The mechanical world is continually being amused by accounts in the daily papers of wonderful inventions which are to entirely revolutionize the established practice, and demonstrate the utter fallacy of long accepted and well understood principles of mechanics.

The latest specimen in this line is the scheme of a genius who has invented and built a locomotive, in which are embodied some very radical departures from established practice in locomotive building.

The machine is illustrated and described in a recent issue of a Boston daily; the writer of the article evidently being possessed of much more enthusiasm for his subject than knowledge of locomotive and railroad matters.

It is very refreshing to a mechanic to read a description of a locomotive by a writer who refers to the main rods as "the main bars which connect the forward driving wheel with the cylinder," and who makes the statement that with the present form of locomotive it is necessary to reduce the speed to 15 miles an hour *in going around curves.*

The new engine has only one pair of driving wheels, and instead of the tires being round, they are provided with "105 facets," or flat places "two inches long." It is furthermore announced that an ordinary tire bears upon the rail only upon a mathematical line, which is the reason that it lacks adhesion and does so much slipping, while the new "wheel will always have two inches of surface lying flat on the rail," a statement which, to a mechanic, is quite entertaining, to say the least of it.

The assumption upon which the whole affair is based, viz.: that adhesion would be increased by increasing the surface of contact between the tire and the rail—if such a thing were possible—is contrary to well-established laws of friction, and has been repeatedly disproved; but such trifling obstacles are of course not allowed to stand in the way of a genius and a newspaper reporter who start out to revolutionize things, and a claim is therefore confidently put forth that this engine, on account of the absence of "side bars" and the increased frictional surface will pull more cars and go around curves much faster than the engines now in use, and up hill as fast as down hill. "This being the fact, it will be seen that the particularly fast time of six hours to New York can be shortened very considerably."

Locomotive engineers have a very strong antipathy to flat places on driving wheel tires, even one such place being strongly objected to, and we imagine it would be interesting to be present at an interview in which the genius was trying to persuade an engineer to make the attempt to shorten the time between Boston and New York with an engine having, not one, but 105 flat places on each driver.

Altogether, we do not remember to have seen an article relating to a mechanical matter in which the statements and claims were more unanimously and ludicrously absurd, and if the engine ever revolutionizes anything, it will probably be the pocket-books of those who may be induced to become interested in it.

Present Tendency in the Manufacture of Firearms.

What at the first glance seem to be paradoxical operations are now taking place in the manufacture of firearms. The tendency in the manufacture of cannon is to make them constantly larger and heavier; to throw heavier projectiles to greater distances, and with greater destructive force. On the other hand, there is a decided movement among the European nations to reduce the caliber of the rifles used by infantry, and such a reduction is under consideration by the military authorities of our own country.

Germany having recently equipped its army with a repeating rifle at enormous expense, and having kept its armories at work night and day to get ahead of France in the matter, is now to begin all over again with a new small bore rifle, because the French have a small bore. The new arm will have a caliber of eight millimeters, or .315″—a reduction from the present one of .117″. The rifle adopted by the French is of only .307″ caliber, and is provided with a magazine which carries eight cartridges. A new concentrated and smokeless powder is used, and a steel bullet. At customary ranges the trajectory is almost flat, which, of course, results in greater precision of fire.

Not only France and Germany, but Austria, England, Holland and Italy are moving in the same direction. All the arms are to be provided with magazines, and the advantages claimed are greater precision, rapidity of fire, and the fact that the soldier will be able to carry about twice as many cartridges as is possible with the arms of larger bore.

The European nations watch each other very closely in the matter of armament, and if any one of them adopts a superior arm, it infallibly results in improvement by all the rest, the decided effect on the soldier's morale, of the confidence resulting from the knowledge that he carries as good an arm as the one in the hands of the enemy, being appreciated at its full value.

Our readers will be pleased to know that George Escol Sellers is to contribute further articles upon "Early Engineering Reminiscences." In a recent letter from Mr. Sellers, he informs us that he has been away from home for a few months, taking a vacation, as it were, and that he has returned and has another article nearly ready. Those who read Mr. Sellers' vigorous articles will be interested in knowing that he is now more than eighty years old, that he has always been a busy man, and was well entitled to a little recreation.

Railroad Commissioners and the Standard Oil Trust.

In the fight which the people of this country are evidently destined to make with gigantic monopolies and abuses which seek to strangle legitimate trade, and control all avenues and means by which the necessaries of life are to be obtained, the fact must be faced, that those who engineer these affairs are men of exceptional ability, are able to devote much time and money to devising and arranging their schemes, and entirely unscrupulous in carrying them out.

As an additional evidence on this already well understood point, some testimony has been recently brought out before the Inter-State Commerce Commission, which is interesting as going to show some of the methods of the Standard Oil Company in its efforts to supply to every citizen his necessary illuminant.

A certain proportion of the profits of the combination is paid to each member of the trust, and if, for any reason, it is thought desirable to shut down any certain factory for a time, its owners still draw their share of the general profits. Thus it is clear that if the trust can secure the levying of very heavy charges for the transportation of oil over any road which must be used by one of their competitors in reaching his market, they can then shut down their own factories, depending on that road, until the strength of the opposition is exhausted, and it is compelled to yield. By this arrangement, the prohibited discrimination in rates by the railroad is avoided, and yet the object of the monopoly is attained by crushing out competition.

QUESTIONS AND ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(506) W. J. C., New Brunswick, N. J., writes: I am desirous of knowing how an ordinary steam engine piston is constructed, the arrangement of the rings, etc. *A.*—See AMERICAN MACHINIST, page 6, June 11, 1887, and page 4, June 25, 1887.

(507) O. S. S., Morenci, Mich., asks: 1. What would be the size of a brick made ¼ size, the standard brick being 2″ x 4″ x 8″? *A.*—According to the general understanding and practice among mechanics, it would be ½″ x 1″ x 2″. 2. What would be the size of a drawing made ¼ size of same? These questions are to settle a dispute. *A.*—½″ x 1″ x 2″.

(508) J. S., Hoboken, N. J., writes: Please give me the size of the ventilator necessary to take off the moisture from a drying room (foundry) of the following dimensions: 12′ x 9′ x 7 with 12 hanging horses. The steam coil is 6 x 8 feet 1 inch pipe with 50 pounds pressure. *A.*—For the area of clear opening of ventilator allow 3 square inches for every square foot of the radiating surface of the coil.

(509) R. B., Brooklyn, N. Y., asks: 1. What is the average length of steam cylinders to their diameter? *A.*—There is no way of stating an average. In some cylinders the stroke is five or six times the diameter, in others no more than half. In stationary engine practice they generally run from stroke, equal to diameter to stroke three times the diameter. 2. What is meant by expansion eight fold, sixteen fold, etc.? *A.*—When steam follows ⅛ of the stroke the expansion is said to be eight fold, and so on.

(510) A. C. B., Windsor, Conn., writes: My teacher says that he thinks air has been reduced to a lump or solid. Will you kindly inform me if it has been done, and if so, how? *A.*—In Prof. John Tyndall's book, "Heat a Mode of Motion" (sixth edition), it is stated that air has been liquefied, a description of the manner of doing so, with some unsuccessful attempts, is also given in the same book. We have never heard of air being reduced to a solid, and believe it has not been done.

(511) W. H. S., Kittanning, Pa., asks: Why are two main air reservoirs carried on the locomotives of the P. R. R.? *A.*—To obtain a sufficient capacity for air. One tank whose capacity is as great as the sum of the capacities of the two reservoirs would be inconvenient to use, and in fact, on some engines, room cannot be found for it.

(512) J. H., Cleveland, Ohio, asks: 1. Will an application for a patent be rejected if it is wholly written instead of using a printed blank, such as is used by patent solicitors? *A.*—A patent could not be rejected on that ground. 2. Is there anything better than clear water for washing blue prints? *A.*—Not that we are aware of. Your other questions cannot well be answered unless you know the date of the issue in which the article appeared, but we think the usual practice is to give to the face of pulleys a certain amount of crown or taper per foot, regardless of width.

(513) E. A. R., Boston, Mass., writes: In order to settle a dispute please state which of the two locomotive works has built the greatest number of engines in the last five years, the Baldwin Locomotive Works in Philadelphia, or the London and Northwestern Locomotive Works in Crewe, England? *A.*—We believe the Baldwin Locomotive Works of Philadelphia has turned out the greatest number of locomotives. In fact, we believe that the Baldwin Locomotive Works turns out a greater number of engines in each year than any other locomotive works in the world.

(514) A. F. B., New York, writes: Will you kindly inform me what the safe steam pressure of a cast-iron jacket kettle may be? It is a small one and fed by a ¾ inch pipe with an ¼ inch exhaust. Please inform me what the steam gauge on boiler should show to make it safe for the kettle with above conditions? *A.*—You do not give any conditions; before we can answer your question we must know the dimensions of the kettle. But we may state this, that there will be no difficulty in making the jacket strong enough to stand any pressure which the steam gauge may show and which you may need.

(515) G. H. C., Brooklyn, N. Y., asks: Will you kindly inform me as to the requirements for obtaining an engineer's certificate? Is it requisite to be a citizen? *A.*—You need not be a citizen. If you wish to obtain a marine engineer's license you will have to apply to the inspectors of the district in which you reside. If you wish to obtain in New York city a stationary engineer's license you will have to apply at the police headquarters in Mulberry street, New York city. Different regulations exist in other cities, which you may easily obtain by inquiring at police headquarters. In all cases you will have to pass an examination.

(516) C. C. B., East Vassalboro, Me., writes: I am runnng an engine whose cylinder is 12 inches diameter and stroke 20. The steam ports are 5/8″ x 8½″; exhaust port 1 1-7″ x 8½″. The valve has ¼ inch lap, and ⅛ inch inside lap; bridges, 1 inch thick; travel of valve, 2⅛ inches, and lead 1-16 of an inch. If I cut out the ⅛ of an inch inside lap, making the valve line and line, will I get any more power from the same amount of steam, or in what way will it affect the engine? *A.*—You will not gain anything by cutting out the inside lap unless you run at very high speed; if you do cut it out, the exhaust steam will be released a little sooner, that is, with the inside lap, steam will follow the piston from about 7/8 of an inch to 1 inch further than it will follow with the lap cut out.

(517) W. H., Dover, N. J., writes: I would ask: 1. Which is liable to roll the most, a wide steamboat or a narrow one, both having the same draft of water? *A.*—That will depend greatly upon the relative height of the loads; but if both are loaded alike the narrow one will roll the most. 2. Will a screw steamer roll more than a steamer with paddle wheels, both having the same draft? *A.*—If the lines of both ships are alike, the screw steamer will roll the most. 3. A steamer draws 26 feet of water and has a propeller 24 feet 4 inches in diameter; do you think the propeller is too large, as it is not more than 1 foot 8 inches below the surface of the water? *A.*—Your question is very indefinite; considerable more data would be required to answer it; but on general principles we should say the propeller is not too large.

(518) O. M., Cincinnati, Ohio, writes: 1. We have a 20 horse-power return flue boiler which we charge in winter with steam from another boiler. Is it best to cover flues with water when so in use? *A.*—You do not state whether you have a fire in the boiler or not. If you have a fire in boiler, then by all means cover the flues with water. If not, we believe it will also be best to have the flues covered with water, which will retain the heat of the steam better than when no water is used. 2 How can we keep the inside of boiler from rusting when not in use during the summer? *A.*—There are several ways of preventing the boiler from rusting. Probably the best way is to blow out the water while hot, allow the boiler to dry, and then close it up perfectly air-tight. Others will fill the boiler with water and close it up tight, while again some engineers will nearly fill the boiler with water, pour oil on top of the water, and then let the latter gradually flow out of the boiler, the idea being that as the water flows out the oil will adhere to the plates and keep them from rusting.

(519) E. M, Boston, Mass., writes: 1. I have two steam cylinders that I intend to make a compound engine of. The high pressure cylinder is 2⅛″ x 5½″; the low pressure is 5″ x 5½″. The steam ports in the high-pressure cylinder are 9-32 inch by 2¼ inches; exhaust port, 9-16 inch; bridges, 7-32 inch; valve travel for both cylinders, 1¼ inches. The ports in low pressure cylinder are 4 inches long, and in all other particulars are the same as in high pressure cylinder. The steam supply pipe of the high pressure cylinder is ¾ inch; that of the low pressure 1 inch; the exhaust pipe from low pressure cylinder is 1½ inches. What I want to know is: will these dimensions give good enough results for the money that it will cost to complete the work, or will it be better to make the low pressure cylinder up as a simple engine, on account of the small ports? *A.*—You do not give the speed at which you propose to run, but on general principles the ports in the large cylinder are too small, and we do not think it will pay to use the cylinder at all. In any case we should not recommend making compound engines so small as this. 2. I also intend to make a 3″ x 5½″ yacht engine, with steam jacket exhaust; that is, the exhaust steam to pass from each side of the cylinder around and to the back of cylinder. Will this give better results than to exhaust from one side of the cylinder in the usual way? *A.*—As the exhaust steam is cooler than the steam inside the cylinder, the proper thing is to get it away with the least possible contact with the outside of cylinder. 3. The steam ports in the cylinder are 2¾ inch by ⅜ inch; exhaust, ¾ inch; travel of valve, 1 7-16 inch. What should be the size of steam and exhaust pipe? *A.*—One inch steam pipe and 1¼ inch exhaust pipe will do very well.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

Gear Wheels. See Adv., page 16.

Link-Belting.

Send for catalogue of Link-Belting.

Over 50,000,000 feet of Link Belt in use.

Link-Belt Machinery Co., Chicago and N. Y.

Shafting Straighteners. J. H. Wells, Tampa Fla.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

Lamb Knitting Machine Co., Chicopee Falls, Mass.

Machine work and patternmaking. Anderson Machine Works, Peekskill, N. Y.

Light articles built to order by the American Sewing Machine Co., Philadelphia, Pa.

For Electric Recording Steam Gauge, write Telemeter Co., 44 Barclay st., New York.

The Best Upright Hammers run by belt are made by W. P. Duncan & Co., Bellefonte, Pa.

For Catalogue of 2d hand lathes, planers, etc., write to John Steptoe & Co., Cincinnati, O.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

Solid Nickel-Seated "Pop" Safety Valves. Consolidated Safety Valve Co., 111 Liberty st., N. Y.

R. Dudgeon, 24 Columbia st., New York. Improved Hydraulic Jacks and Roller Tube Expanders.

Davis Key-Seating Machines, kept in stock, by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

The bulldozer forming, forging and bending machine. Williams, White & Co., Moline, Ill., m'f's.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

Ice and Refrigerating Machines, 124 built, and all successful. David Boyle, 521 Monroe st., Chicago, Ill

Selden Packing, for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

Drawing Materials, all kinds. Get catalogue. Mention this paper. G. S. Woolman, 116 Fulton st., N.Y.

Buy the Excel. Upright Drill; sizes, 20″, 25″, 28″, 32″, 36″ swing. Currier & Snyder. Worcester, Mass.

Foundry ladles and shanks wanted; send sizes and prices to Shriver's Foundry, 333 E 56th st., New York City.

The Improved Tabor Steam Engine Indicator, made and sold by The Ashcroft Mfg. Co., 111 Liberty st., N. Y.

Engine Lathes, Hand Lathes, and other fine tools. Assortment large; prices low. Frasse & Co., 92 Park row, N. Y.

For the latest improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago, Ill.

Inventors should write R. G. DuBois, Patent Attorney, 916 F street, Washington, D. C., for reliable information pertaining to patents.

Ten 16 in. Engine Lathes, ten 18 in. Eng. Lathes, ten 14 in. Eng. Lathes, ten 15 in. Engine Lathes. Nicholson & Waterman, Providence, R. I.

The Brown & Sharpe Mfg. Co. have placed at No. 23 S. Canal st., Chicago, Ill., a sample line of milling machines and other machinery with S. A. Smith.

Machinists' supplies, brass goods, m'f'rs' supplies, polishing materials, all kinds wire, metals, etc.; in any quantity. Jordan & Gottfried, 208 Canal st., N.Y.

For Best Return Steam Traps, Pressure Regulators, Positive-Acting Pump Govs., Back-Pressure Valves. T. Kieley, 11 W. 13th st., N.Y. Send for des'n.

Curtis Pressure Regulators, Curtis Return Trap, Curtis Damper Regulator. See Dec. 10, p 15. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

Patents relating to machinery should be secured by experienced mechanics acquainted with the law. Write to A. K. Mansfield & Co., mechanical engineers and patent experts, 280 Broadway, N. Y.

W. H. Hoffman, consulting engineer, 94 Liberty st., N. Y. Mechanical engineering in all its branches; working drawings for the transmission of power by steam, water, air and electricity.

Hot Water Supply. A practical treatise on the fitting of hot-water apparatus for domestic and general purposes. By F. Dye. 82 pages, with 25 illustrations. 12mo., cloth, $1. Send for catalogue. E. & F. N. Spon, 35 Murray st., N. Y

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines, and current practice in testing engines and boilers. Price, $2, postpaid. Published by John Wiley & Sons, 15 Astor Place, New York.

"Binders" for the AMERICAN MACHINIST. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers, the full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUB'G CO., 96 Fulton st., New York.

MANUFACTURES

T. M. Scott is interested in building a machine shop near Hempsted, Texas.

The Elyton Land Company will build boiler and sheet iron works at Birmingham, Ala.

H. M. Winslow is interested in a company organized to build gas works at Carollton, Ky.

Francis A. Clark will build a factory at the corner of First avenue and 98th street, New York.

The Athens (Tenn.) Mining and Manufacturing Company have begun work on a large cotton mill.

R. A. Wallace will build a five-story factory on 10th avenue, between 53rd and 54th streets, New York.

The Hazen Manufacturing Company, Cincinnati, Ohio, has changed its name to the Cincinnati Wire Company.

The Standard Oil Company will erect a cooperage factory in connection with other buildings, at Knoxville, Tenn.

The shops of the Cincinnati Southern Railway, covering two acres of ground in Ludlow, Ky., were destroyed by fire recently.

The contract has been let for building the factory of the Birmingham (Ala.) Safe and Lock Company. It will be 125 x 200 feet, two stories.

The Decatur (Ala.) Car Wheel and Car Spring Company has let the contract to build their shops. The main building will be 75 x 280 feet.

The shops of the Warder, Bushnell & Glessner Co., at Springfield, Ohio, are being furnished with 600 electric lights, at a cost of about $6,000.

The Standard Machine Company, of Bay City, Mich., will build shops at Chattanooga, Tenn., under the name of the Chattanooga Machine Company.

The Lancaster (Pa.) Radiator Company has found it necessary to erect new buildings, and has increased its capital stock and applied for a charter.

The Ohio Falls Car Works, Jeffersonville, Ind., who have recently spent $100,000 in improving their works, have further improvements in contemplation.

Sales of the Babcock & Wilcox boiler for the month of October aggregated nearly 4,000 horse-power, a good proportion of which was on foreign orders.

Good & Tierney, machinists and contractors for engines, boilers and complete factory outfits, have established themselves at 28 to 32 Washington street, Chicago, Ill.

The Rue Manufacturing Company, Philadelphia, Pa., has removed its manufactory to 116 North Ninth street, for the purpose of securing more room for increasing business.

The Niagara Stamping and Tool Company has issued a new illustrated catalogue of tinners' machines and tools. It seems to embrace about everything that tinners require.

The Scottdale Iron Works, of W. H. Everson & Co., at Scottdale, Pa., which were recently sold at assignee's sale, will probably be put in operation during the present week by the purchasers.

The hours of work at Colt's armory, Hartford, Conn., in most of the departments, have lately been increased from eight to ten hours per day. Business in the gun department is better than it has been for some time.

The Waterhouse Electric and Manufacturing Company, Hartford, Conn., are uncommonly busy on electric light orders. They are now filling orders for several large mills, also furnishing an arc light plant for Baltimore, Md., and Newark, N. J.

The contract for the erection of the car wheel and car spring manufactory at Decatur, Ala., has been awarded. There will be several buildings, the main one to be 80 x 275 feet. The works will be in operation by January 1, 1888, and will turn out 100 car wheels a day.

Plans prepared for a better water supply for Allegheny City, Pa., look to taking water from the Allegheny river at Nine-mile island and leading it through a sixty-inch plate steel conduit to the present water-works. Pumping engines of 30,000,000 gallons daily capacity would be needed.

It has been decided that the extensive machine works of the Jones & Lamson Company will be removed from Windsor to Springfield, Vt., Adna Brown, of that place, securing control of the stock of $50,000, which will immediately be increased to $60,000. Extensive shops will be erected at once. The company owns valuable patents and manufactures iron-working machinery.

The Hall Steam Pump Company, 91 Liberty street, New York, has issued a new catalogue very finely illustrated. It contains cuts and descriptions of a large variety of steam pumps, simple and compound, adapted to a variety of purposes; also combined boiler and power pump and independent condenser and pump. Instruction to those ordering pumps is given, with directions for setting up pumps; also useful information for engineers and others.

The Champion Blower and Forge Company, Lancaster, Pa., owing to increase of business, have been compelled to seek new and more commodious quarters. They have contracted for the building of a new foundry 40 x 80 feet, of brick, and have secured a large brick building adjoining, which will be fitted up as a machine shop. In addition to their blowers and forges they make castings of all descriptions for outside parties. They expect to occupy the new foundry about the first of January.

A press dispatch from Bellows Falls, Vt., says: "Parties who have been mining iron and manganese in South Wallingford for several months past have struck, at a depth of 600 feet, the most extensive deposit ever found in this section. The iron is in so pure a state that it is shipped as it comes out to Bessemer, where, being mixed with other metal, it is said to form the best quality of steel. The deposit shows that at some time in the past great heat has caused the melting and running together of the metal, leaving it free from impurity. From 50 to 100 tons per week are being shipped. It bids fair to be a great and paying industry for that section Another lead has been started, which will in a short time reach the depth of 850 feet from the entrance."

The News-Herald, Jacksonville, Fla., says of the new shops of T. Murphy and the Merrill-Stevens Co., of that city: The foundry and machine shop which has just been completed, and which will be occupied by Mr. Murphy early next month, is a substantial corrugated iron building 30 x 70 feet, two stories high, with an L 25 feet square. The lower floor will be used as the machine shop and foundry, while the upper apartment is intended for the making and storing of patterns. The L portion wil be devoted to office purposes. Just east of this is the boiler and blacksmith shop of the Merrill-Stevens Company, thirty feet front and extending back 175 feet, with a space thirty feet square in front, two stories high.

The Standard Foundry Company [St. Louis, Mo.] are preparing for the manufacture of pulleys of every diameter, from 6 inches up to 48 inches, and of any width of face, straight or crown. To this end they are building several pulley moulding machines of improved design, all of which will be in operation by January 1st next. One of the machines, capable of moulding pulleys from 6 to 20 inches diameter, will be started up this month. The very latest improved patterns will be used in this branch of manufacture. To make room for the pulley business, and to permit of larger operations in respect of present specialties, the company will at once enlarge their plant by one-half, and add new appliances. They are now putting in three new cranes.—*Age of Steel.*

We are pleased to notice that a move has been made to bring Western Kentucky into prominence in the manufacture of pig iron. It is proposed to build two large furnaces at Paducah, one to use coke and the other to use charcoal. Major Thomas H. Hays, and Col. C. E. Sears, of Louisville, and Col. W. S. Thomas, of Philadelphia, backed by the Paducah Land and Improvement Company and various railroad interests, are in the front of this movement. These are all well-known gentlemen. It is also proposed by the Grand Rivers Coal, Iron and Railroad Company to establish a new city in Livingston county, to be called Grand Rivers, at which pig iron, among other articles, is to be made. This latter scheme remains for the present in abeyance. It is, however, a fact of much significance that the attention of enterprising business men has at last been turned to this section of the country.—*Bulletin.*

The new steel mill at Hammond (Chicago) will commence operations in a few days. The buildings are all substantial structures, and of modern design. The nail factory and bluing-house is built of brick and stone, while the steel and rolling-mills are built entirely of iron. The rolls and steel mill adjoin the factory on the south, so that the plate iron when rolled and cut is virtually within the factory. The steel mill is constructed on the latest plan, and supplied with all conveniences. One of the principal features of the mill is two large hydraulic pumps by which the steel mill is operated. The steel mill will commence operations in a few days. The rolling mill and a portion of the nail factory have already commenced operations. The factory contains 101 machines, nearly all of which are self-feeders. The total number of machines to be put up is 150. The entire factory is illuminated by electric lights.—*Chicago Journal of Commerce.*

The propositions for the two large overhead traveling cranes for the new gun shops for the U. S. Navy, Washington, D. C., by the Morgan Engineering Company, Alliance, Ohio, have been accepted, and work will be commenced on them forthwith. One is to be completed in ten months and the larger in fifteen months, as follows: One overhead traveling crane to have a span of about 62 feet at a height of about 40 feet above floor line. This crane will have a capacity to lift guns weighing 125 tons, about 200 feet travel lengthwise, and about 50 feet crosswise of shops, and will be one of the largest cranes ever built in the world. Another overhead traveling crane for one of the other gun shops to have a span of about 52 feet, to have a lifting capacity of about 45 tons, to have a travel of about 480 feet. These cranes will cover workshops respectively of about 220 x 62 feet, and 480 x 52 feet, with a lift of about 40 feet. Each of the cranes is so designed as to have various speeds of hoist and travel in all directions to suit the varying weights of loads from the lightest to the greatest or maximum loads, the lightest loads being handled in all directions rapidly, and the heaviest at speeds to suit the greatest activity such load could be handled. Automatic stop motions are placed on the various motions that automatically prevent the travel of cranes in any direction beyond their maximum limits, thereby preventing (through neglect or otherwise, on the part of operator) accidents of any kind through such neglect. The magnitude of these immense cranes can best be imagined when it is considered that it will take from fifteen to twenty freight cars to ship them. These cranes will, it is claimed, place our gun shops of Navy department in regard to handling work equal to any such institutions in the world.

Machinists' Supplies and Iron.

NEW YORK, Dec. 1, 1887.

Iron—American Pig—The demand has been moderate and almost entirely confined to small lots for immediate delivery. The market has ruled quiet and steady, but trade has developed no new features. There appears to be very little desire to provide for future requirements, but furnacemen say the outlook is not discouraging, current production being very fairly absorbed, with the prospect that prices will be steadily maintained. There is nothing to indicate any special change in the situation. No. 1 X Foundry can be had at $20.50 to $21.50, according to brand; No. 2. X at $18.50 to $19.25, and Grey Forge at $16.50 to $17.25.

Scotch Pig—The market has ruled quiet and steady, and is without new features or quotable change. We quote Coltness, $21.25 to $21.50; Glengarnock, $19.75 to $20.25; Gartsherrie, $21 to $21.25; Summerlee, $20.75 to $21; Eglinton, $19 to $19.25; Langloan, $20 to $20.50; Dalmellington, $19.75 to $20, and Clyde $19.50 to $20.

Lead—Considerable business has been transacted at higher prices, as the result of the firmer tendency of the market, which has ruled strong and active. About 1,200 tons Western, spot and December and January deliveries, have been taken by consumers at 4½c. to 4.55c and 4.60c.

Antimony—There has been no change of importance in the value of Regulus. There is a fair jobbing demand, supplies being firmly held at 9¾ cents for Hallett's and 9¾c. for Cookson's.

Copper—Transactions in the market have been quite active, chiefly on account of the operations of speculators. Prices have ruled at 14.35 up to 14.95 cents per pound for spot, and 14½ to 14.95 for December.

Tin—There has been a steady upward movement of prices, the speculators in Europe having caused prices there to rapidly advance. The market here has responded with higher prices, bu trading both here and there has been light. The available stock here is comparatively light, and dealers and consumers are buying only to supply immediate wants. We quote Straits and Malacca 35½c. cash, and 35⅛c to 36, 30 days.

✲WANTED✲

"Situation and Help" Advertisements only inserted under this head. Rate, 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

Wanted—As foreman, a capable man thoroughly familiar with all kinds of shop work. Address R, AM. MACHINIST.

A good machinist (lathe hand); steady, reliable workman, wants employment. Address H. J. B., 117 E Chicago ave., Chicago. Ill.

Wanted—A position as superintendent or foreman of machine shop; all kinds of machinery; best of references. Address W. L. S., AM. MACHINIST.

Wanted—Situation as foreman boilermaker by a man of experience on all kinds of boiler work; good references; age 35. Eclipse, AM. MACHINIST.

Wanted - Foreman for brass finishing department; must be experienced in valve and cock work. Address with reference and salary, Valves, AM. MACHINIST.

Wanted—A man who is capable of laying out all kinds of work in a boiler shop; one who thoroughly understands his business. Address, giving past experience, Layer Out, AM. MACHINIST.

A young technical graduate wants work under a skillful man; has experience in drawing room; is a practical machinist; good mech'l ability; intelligent and steady. Address, H., 357 Court st., B'klyn, N. Y.

Wanted—Situation as foreman boiler maker; have had long experience on all kinds of marine, stationary, and locomotive work; no objection to any part of the U. S. Boiler Maker, 689 Notre Dame st., Montreal, Canada.

Wanted—Foreman for college shops, to begin March 1, 1888; $1,000 salary for eight months' work per year; must be a young man, energetic, well posted, a first-class machinist, and able to teach pattern making. Please give experience in detail and references. Address Room 81, 189 La Salle st., Chicago, Ill.

Wanted—Two good machinists, accustomed to sectional tap and die work, in new pipe mill at Wheeling; steady work for right men; men accustomed to tube works practice will have the preference. Reply, giving reference and wages expected, and how soon can come. Riverside Iron Works, Wheeling, W. Va.

Wanted—A thoroughly practical and experienced draftsman and machinist capable of taking charge of works; 20 to 40 men employed when busy; business carried on, manufacture of marine and stationary engines, saw mill machinery, railroad and general iron work; will pay good salary to the right man. Address S. F. G., P. O. Box 25, St. John, N. B., Canada.

✝ MISCELLANEOUS WANTS. ✝

Advertisements will be inserted under this head at 35 cents per line, each insertion.

Crescent steel tube scrapers are unquestionably the best. Crescent Mfg. Co., Cleveland, Ohio.

Crescent boiler tube cutter, for setting new and removing old tubes. Crescent Mfg. Co., Cleveland, O.

Wanted- Parties having machinery specialties to build, to correspond with. Box 75, AM. MACHINIST.

For Sale—One improved Tabor steam engine indicator, cheap, used but once. S. M. Mallalieu, Coatesville, Pa.

Wanted—20″ to 24″ second-hand engine lathe, in first-class order; give full particulars and cash price. Bargain, Box 76, AM. MACHINIST.

For Sale—Pond planer 40 x 36, to plane 12 feet; in good order, with chuck, at $950; also several second-hand bolt cutters. S. M. York, Cleveland, O.

A. C. Christensen, 26 Church st., N. Y., mech. and hydraulic engineer, late chf. draftsman at H. R. Worthington. Designs and working drawings of water works, pumps, gen. mach. & pat drawings.

For Sale—39″ x 12′, 2·″ x 16′, 18″ x 9′ screw cutting lathes; Daniels wood planer, 20″ x 18′; Hotchkiss belt power hammer ram, 100 pounds, air cylinder, 4″ x 16″; all second-hand, in good order. J. & G. Rich, 120 N. 6th st., Phila., Pa.

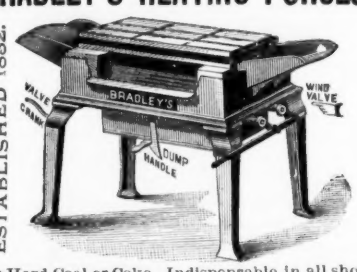
BRADLEY'S UPRIGHT CUSHIONED HELVE HAMMER

Established 1832.

Combines all the best elements essential in a first-class Hammer. Has more good points, does more and better work and costs less for repairs than any other **Hammer** in the **World.**

BRADLEY'S HEATING FORGES.

ESTABLISHED 1832.



For Hard Coal or Coke. Indispensable in all shops to keep **Bradley's Cushioned Hammers** and men fully employed and reduces cost of production.

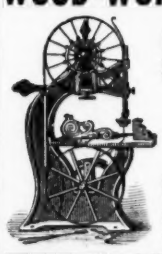
BRADLEY & CO. Syracuse. N.Y.

STEPHENS PATENT VISES.

ONE-HALF TIME and LABOR saved by using this solid, strong, durable, firm-hold, quick-working Lever (Not Screw) Vise. Has improved Taper-Pipe and other attachments. Sold by the trade. Send for circular

TOWER & LYON,
95 Chambers Street, New York.
Successors to MELVIN STEPHENS.

J. A. FAY & CO. CINCINNATI, OHIO, U.S.A.
BUILDERS OF IMPROVED
WOOD-WORKING MACHINERY



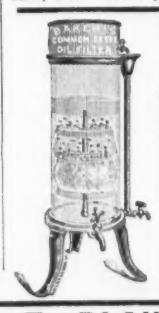
Embraces nearly 400 Machines for
PLANING & MATCHING
Surfacing, Moulding, Tenoning, Mortising, Boring, and Shaping, etc.
Variety and Universal
WOOD WORKERS.
Band, Scroll and Circular Saws, Resawing Machines. Spoke and Wheel Machinery, Shafting, Pulleys, etc. All of the highest standard of excellence.

W. H. DOANE, Pres't. D. L. LYON, Sec'y

JOHN WILEY & SONS, 15 ASTOR PL., NEW YORK.
—PUBLISHERS OF—
SCIENTIFIC & INDUSTRIAL WORKS.
Send for Catalogues and Circulars.—Free by mail.

AUCTION SALE OF MACHINERY.

The tools of the WALNUTPORT MACHINE WORKS, Walnutport, Pa., will be sold at auction at that place, Thursday, Dec. 15th, 1887, at 1 P. M. Send for Catalogue of Machinery to W. W. BOWMAN, Lehighton, Pa. Sale positive.



Baker's Common Sense Oil Filter.

Is the most **Simple, Neat, Ornamental, Effective, Complete** and **Convenient OIL FILTER** in the Market. The whole **operation** is **visible,** and any ordinary man can operate it **successfully.** It will pay for itself the first year, if a little pains is taken to catch the waste oil from your Engine, Dynamo, Shafting, etc., etc. Manufactured and for sale by **CHAS. F. BAKER,**
223 Third Ave., S. E., MINNEAPOLIS, MIN.

GEO. F. BLAKE MANF'G. CO.
BUILDERS OF EVERY VARIETY OF

95 & 97 LIBERTY ST., NEW YORK. 111 FEDERAL ST., BOSTON.
WATER WORKS PUMPING **ENGINES A SPECIALTY**

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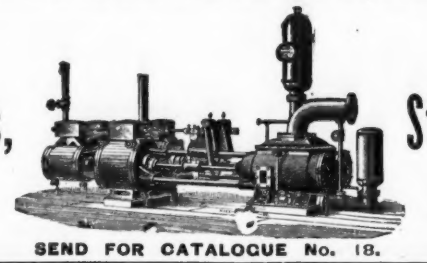

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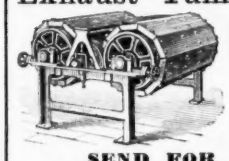

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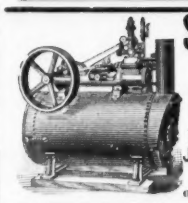

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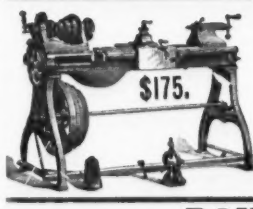

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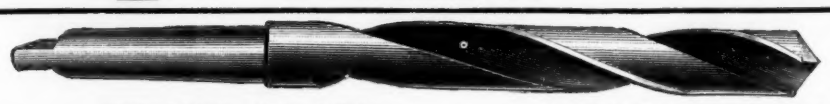

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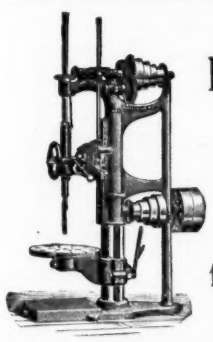

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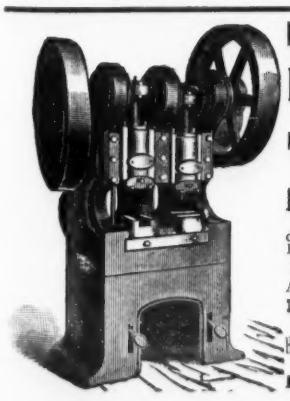

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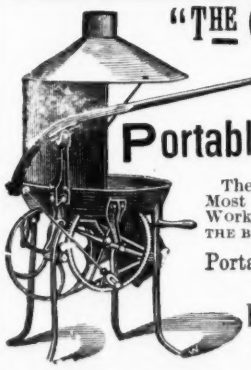

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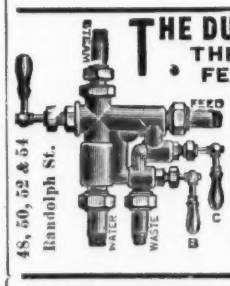

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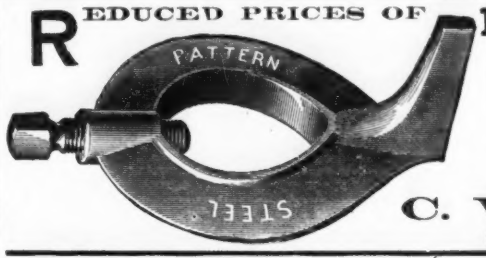

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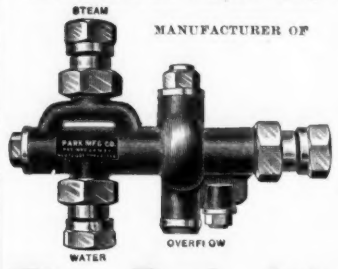

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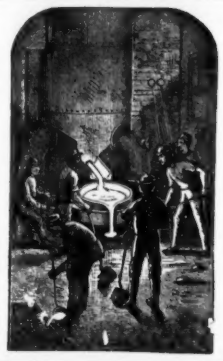

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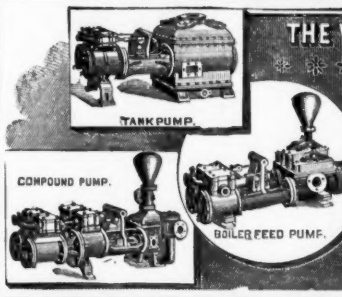

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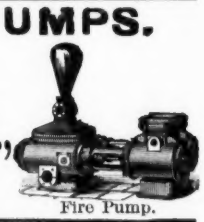

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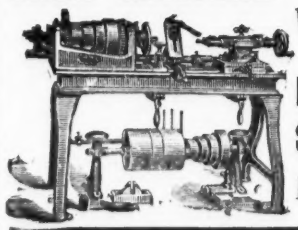

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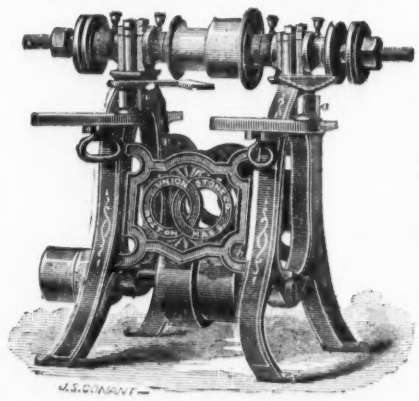

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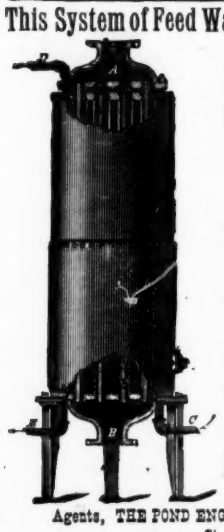

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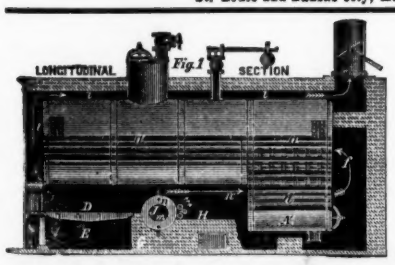

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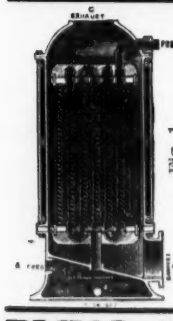

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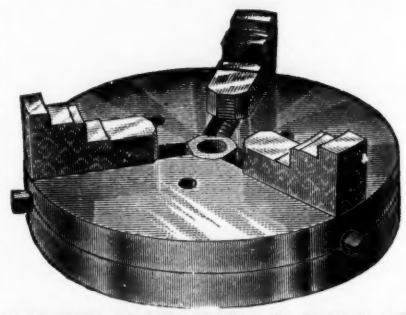

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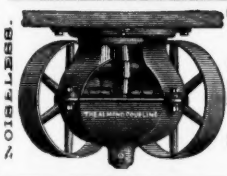

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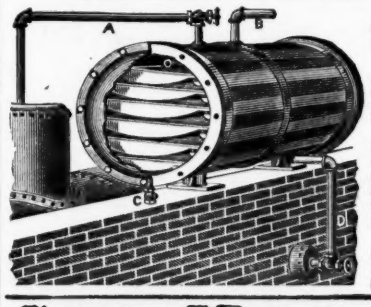

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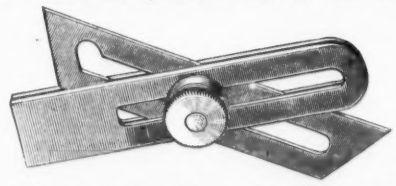

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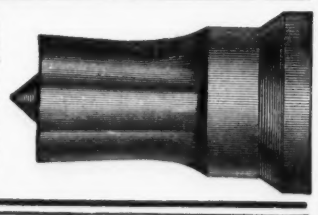

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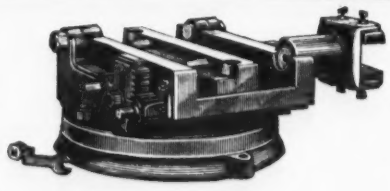

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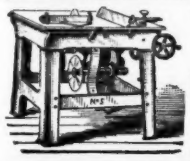

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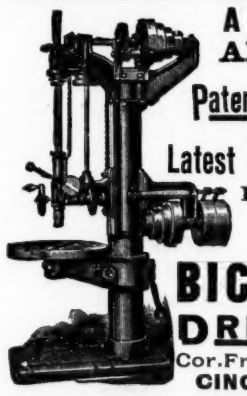

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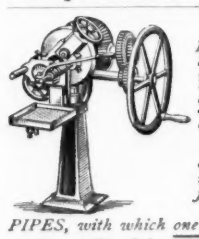

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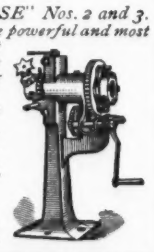

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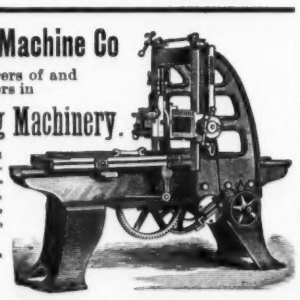

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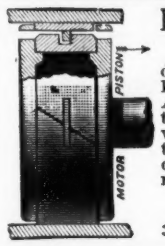

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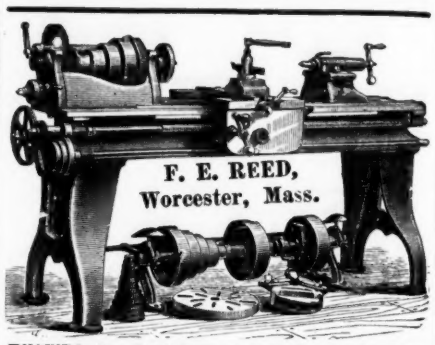

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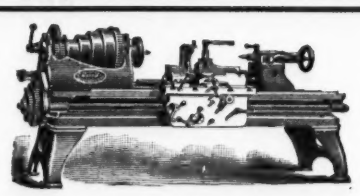

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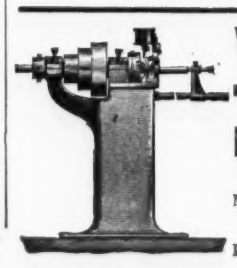

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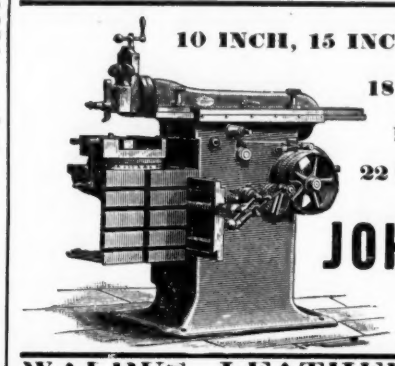

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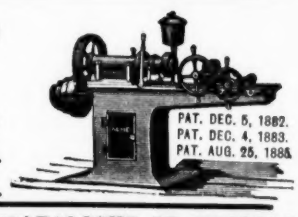

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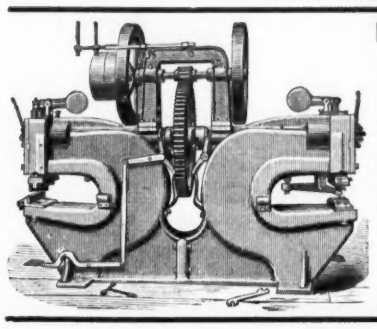

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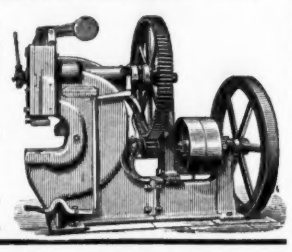

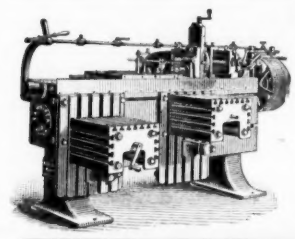

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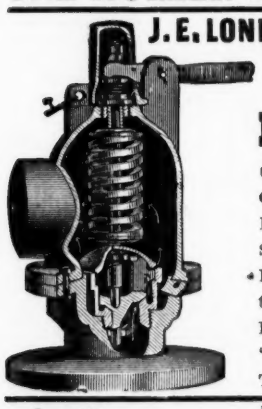

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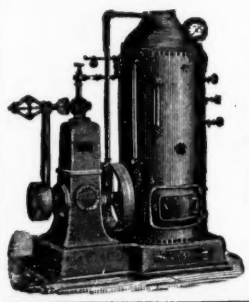

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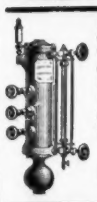

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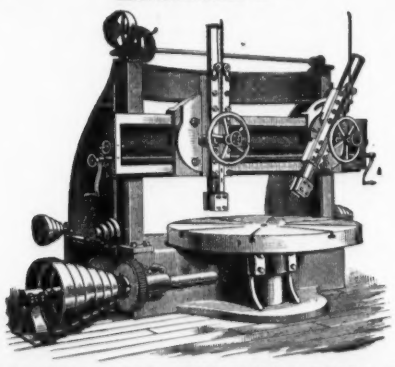

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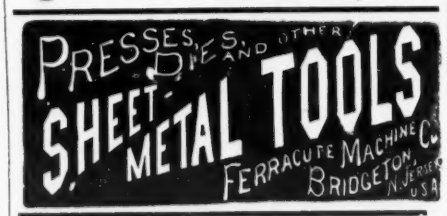

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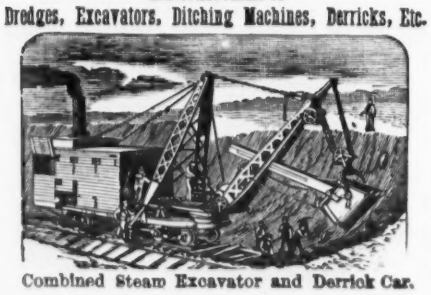

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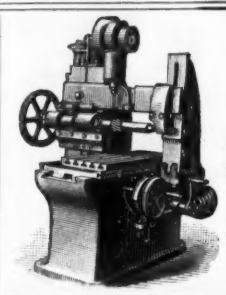

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HOMESTEAD STEEL WORKS.

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Gentlemen: Replying to yours of 5th we can cheerfully say the open side planer furnished us by you does everything claimed for it. We find it very strong and rigid, runs very smoothly and takes heavy cut. We can do a great deal of work on much larger pieces than could be handled on ordinary type of planer of same size.

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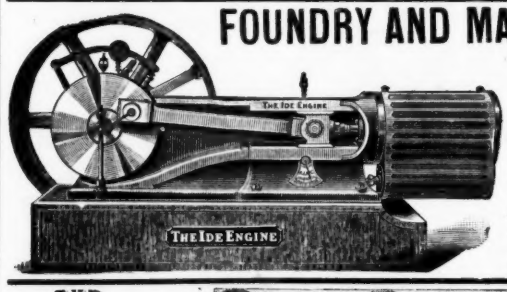

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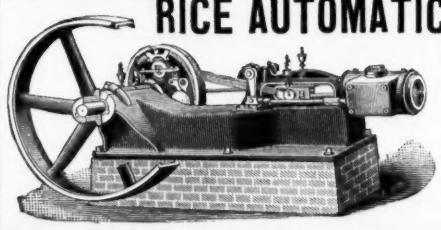

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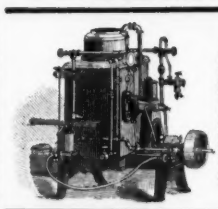

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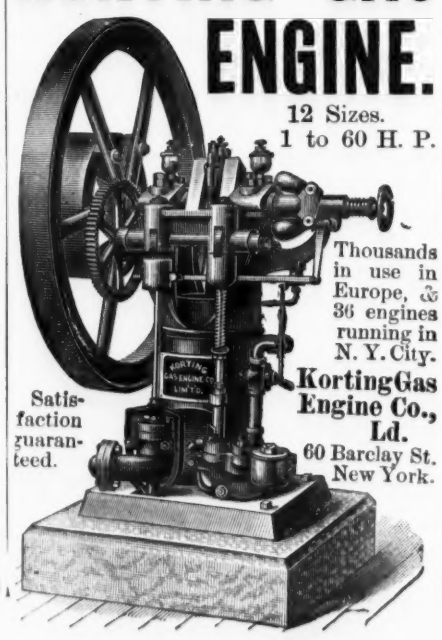

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One 70 H. P. Stationary Boiler		" "
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Two 40 H. P. " "		" "
One 30 H. P. Vertical "		" "
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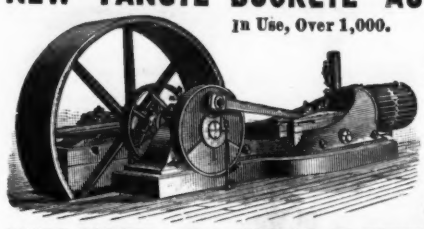

These engines are the combined result of long experience with automatic cut-off regulation, and most careful revision of all details. They are designed and constructed for heavy and continuous duty at medium or high rotative speeds Highest attainable Economy in Steam Consumption and superior regulation guaranteed. Self-contained Automatic Cut-off Engines 12 to 100 H P for driving Dynamo Machines *a specialty*. Illustrated Circulars, with various data as to practical Steam Engine construction and performance, free by mail. **Address, BUCKEYE ENGINE CO., Salem, Ohio.**

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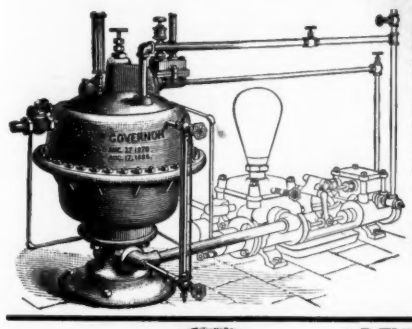

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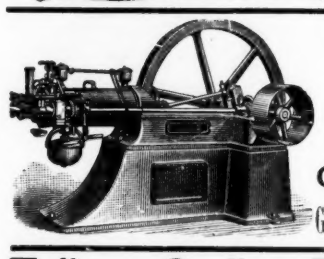

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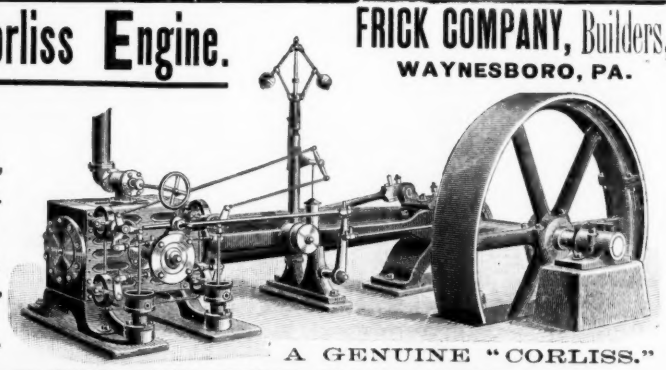

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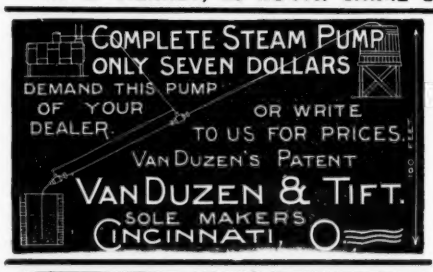

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22 in. x5 ft.	"	Hendey,	new.
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26 in. x7 ft.	"	Brettell,	new.
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Full set of gears to cut from 2 to 18 threads including 11½ pipe thread. *Automatic stop on carriage. Separate screw and rod feed*, and the most substantial and easily managed *taper attachment* made. Cones and gears of large diameter and wide belt. Studs, screws and small gears are *steel or gun metal*. Webbed live heads, heavy tail stocks. No worm or worm gears, no weak reverse plate. *Perfect lubrication for all running parts*, including carriage.

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GUARANTEE.

We guarantee this lathe to be equal in workmanship, truth, accuracy, solidity, material and finish, to the best made, and hold ourselves legally liable for this guarantee.

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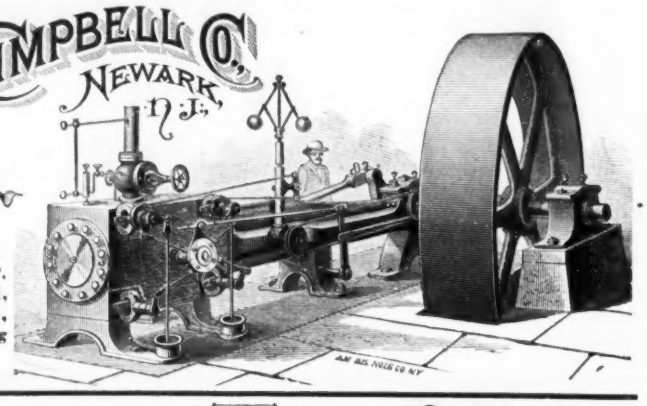

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Complete Motive Power Plants Furnished.

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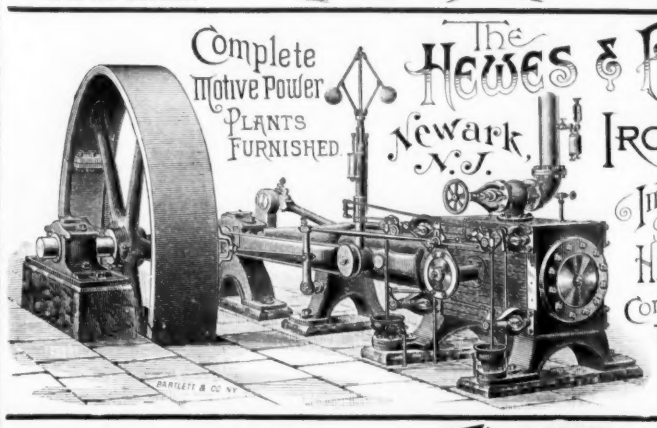

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GEO. A. BARNARD, AGENT.

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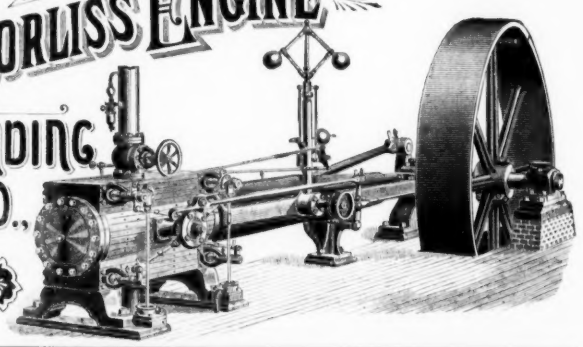
BUILT BY THE FISHKILL LANDING MACHINE CO., FISHKILL ON THE HUDSON, N.Y.



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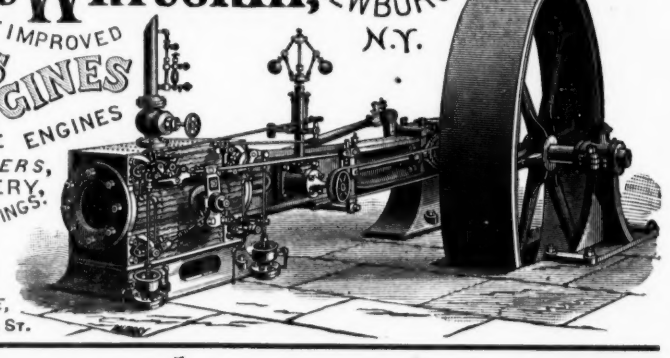

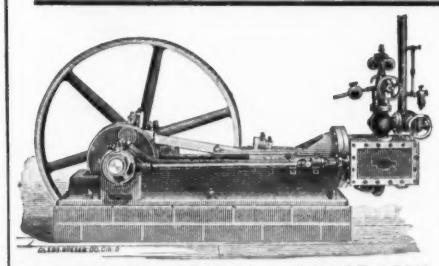

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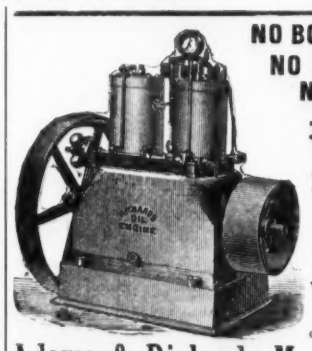

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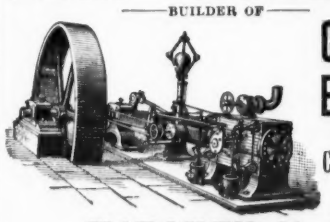

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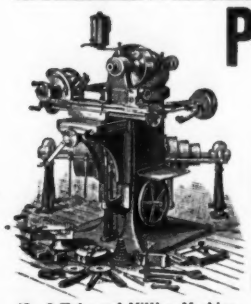

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Universal Milling Machines

MADE BY THE

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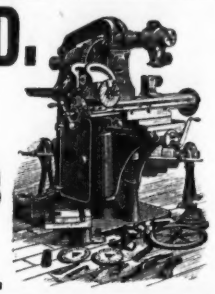

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Are kept in stock and sold at favorable prices, compared with any of their **IMITATIONS.** *By making these Machines in large numbers, with expensive special tools, much greater accuracy has been attained than can be reached by the usual methods of manufacture. The importance of the greatest attainable accuracy in* **TOOL-MAKING MACHINES** *will be appreciated by Machinists.*

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IRON-WORKING MACHINERY

OF EVERY DESCRIPTION.

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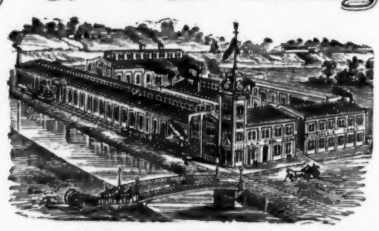

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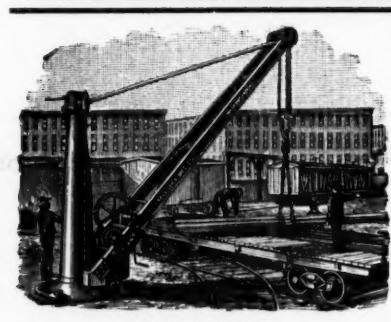

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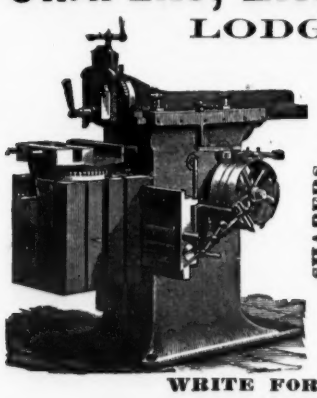

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20 inch Upright Drills. 26 inch Back Geared
24 " " " and
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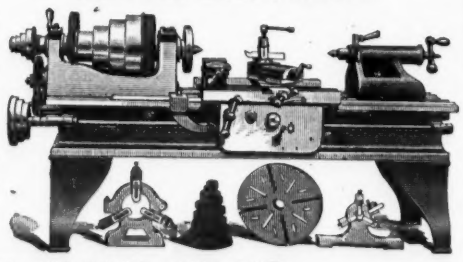

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(See special notice of Engine Lathes on page 15.)

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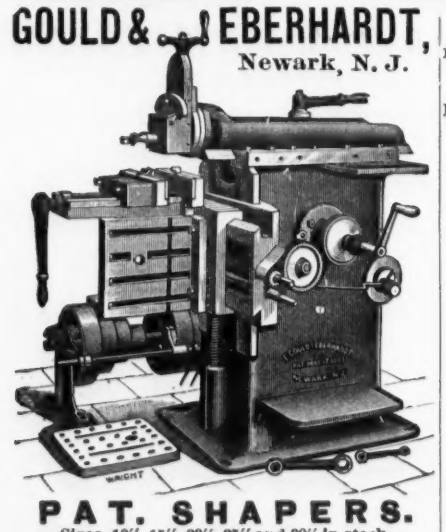

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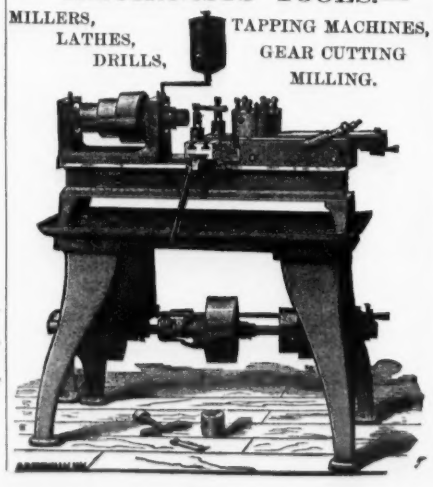

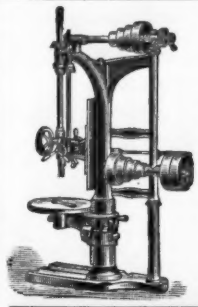

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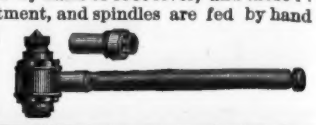

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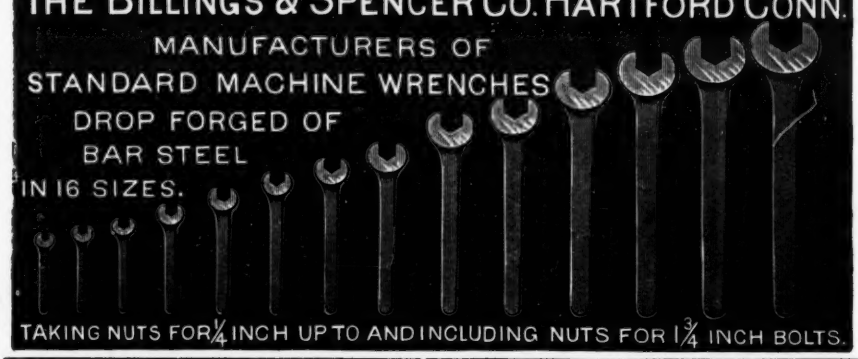

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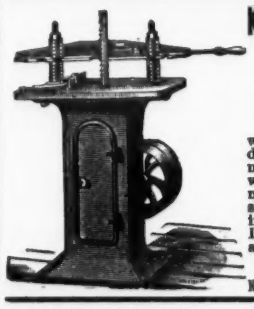

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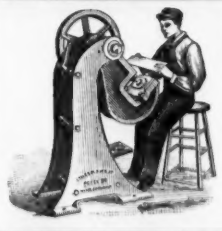

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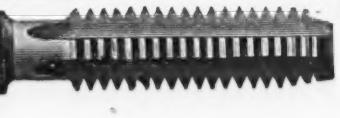

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